Volume 22, Number 20, October 31, 1968

NUCLEAR SCIENCE ABSTRACTS

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Index References

All index entries refer the reader to volume and abstract number:

FOURRIER, Alain
Radioactive chain of mass number 189, **21:10023**

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Every author's name is indexed in the form appearing on the document abstracted:

MONTH, M.
Theory of gradient perturbations in AGS, 21:9872 (BNL-10899)
MONTH, Melvin
Simple relativistic calculation of the electromagnetic form factors of the deuteron, 21:9744

Subjects

The subject index consisting of specific materials, objects, and processes is arranged alphabetically. Modifying phrases specific to these subjects in turn are arranged alphabetically under the subjects.

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Corporate Authors

Technical report literature is indexed from the name of the organization or institution responsible for the issuance of the report.

8500 (Y-1561) MIXING AND SAMPLING ENRICHED ^{235}U FLUIDS IN CYLINDRICAL STORAGE CONTAINERS. Final Report. Harrell, J. E. **(Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant).** Jan. 17, 1967. Contract W-7405-eng-26. 124p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

is indexed as:

UNION CARBIDE CORP., OAK RIDGE, TENN. Y-12 PLANT.
Mixing and sampling enriched ^{235}U fluids in cylindrical storage containers, 21:8500 (Y-1561)

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Technical report literature is also indexed by report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

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3311(Suppl. 2)	21-8567	Dep. mn. CFSTI $3.00 cy, $0.65 mn
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23287	21-8498	Dep. mn. CFSTI $3.00 cy, $0.65 mn
23420	21-8764	Lancet, 2: 672-5(Sept. 24, 1966)
23474	21-8528	Dep. mn. CFSTI $3.00 cy, $0.65 mn
23478	21-8641	Dep. mn. CFSTI $3.00 cy, $0.65 mn
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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 42653, 42831, 42873, 43044, 43080, 43089, 43131, 43148, 43301, 43352, and 43522.

42581 (AAEC/TM-438) DIRECT READING SPECTROMETER FOR THE DETERMINATION OF BERYLLIUM IN SITE LIQUID EFFLUENT. Dale, L. S. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Feb. 1968. 19p. Dep.

A single channel direct reading spectrometer for the determination of beryllium in liquid effluent samples from delay tanks on the site of the Australian Atomic Energy Commission's Research Establishment is described. The rotating disc technique with pulsed arc excitation is used to determine beryllium down to 0.1 ppM. The limit of detection is 0.01 ppM and the coefficient of variation at the 0.1 ppM level is ±20% for a 95% confidence level. The beryllium intensity is depressed by the presence of other constituents in the effluent. Calibration is therefore carried out with standards prepared from a composite effluent solution which yields a similar depression of the beryllium intensity. The results are biased for different tanks and range from +20% to -10%. The nature of the depression of the beryllium intensity was studied in relation to the interference effects of foreign anions and cations and the sensitivity of the method is shown to be affected by pH and by the grade of graphite discs used. (auth)

42582 (AAEC/TM-446) NONDESTRUCTIVE DETERMINATION OF THORIA IN SINTERED THORIA-BERYLLIA BLOCKS. Champion, K. P.; Matulis, C. E.; Whittem, R. N. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). May 1968. 10p. Dep.

An x-ray spectrochemical method using incoherently (Compton) scattered primary radiation as internal standard is used to correct for bulk density effects, and to provide an almost linear calibration curve for thorium in beryllium oxide-thoria samples. (auth)

42583 (AD-665357) ^{239}Pu DETERMINATION BY RESIN PAPER ION-EXCHANGE SEPARATION AND LIQUID SCINTILLATION COUNTING. Crisco, Carl; Lada, Henry F. (Army Nuclear Defense Lab., Edgewood Arsenal, Md.). Jan. 1968. 23p. (NDL-TR-97). CFSTI.

The use of strongly basic anion-exchange resin paper provides a simple and relatively short assay method for direct isolation and subsequent liquid scintillation counting of ^{239}Pu alpha particles. Various adsorption techniques, specificity, and cross-contamination were studied in the presence of the fission products ^{89}Sr, ^{90}Sr, ^{95}Zr, ^{106}Ru, ^{137}Cs, and ^{144}Ce. Resin paper separation of a pure ^{239}Pu solution and a diverse ion solution, prepared from ^{239}Pu contaminated soil, was compared with separation by anion-exchange resin column, thenoyl trifluoroacetone (TTA) liquid-liquid extraction, and zirconium phosphate microcrystal column. The conclusions were that the type SB-2 strongly basic anion-exchange resin paper: adsorbs ^{239}Pu from a 7.5$\underline{N}$ HNO3 solution; applies to solutions containing small amounts of fission products; compares favorably in reproducibility and recovery efficiency with thenoyl trifluoroacetone (TTA) solvent extraction and zirconium phosphate microcrystal column separation techniques; and provides a simple and relatively quick procedure for analyzing large numbers of samples. (auth) (USGRDR)

42584 (ARH-SA-13) DETERMINATION OF GALLIUM IN PLUTONIUM BY ATOMIC ABSORPTION. Miller, A. G. (Atlantic Richfield Hanford Co., Richland, Wash.). June 7, 1968. Contract AT(45-1)-2130. 12p. Dep. CFSTI.

An atomic absorption method was investigated for determination of gallium in plutonium. The extraction of gallium by 5% Aliquat 336 in methyl isobutyl ketone was demonstrated to be quantitative for conditions encountered in this application. The precision was not so good as that possible with the fluorimetric method. (M.C.G.)

42585 (CEA-N-674) AVAILABILITY OF ^{137}Cs GAMMA-RAY SOURCE IN X-RAY FLUORESCENCE ANALYSIS FOR HEAVY ELEMENTS. Enomoto, S.; Martinelli, P. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jan.-Mar. 1966. 15p. Dep.

Use of a ^{137}Cs source in x-ray fluorescence spectroscopy is illustrated by determination of lead in aqueous solutions and powder mixtures. Use of a 11.9-mCi ^{137}Cs source with a 1-mm-thick NaI(Tl) scintillation counter shows promising results. The ratio of the count rate in the K x-ray channel to that of the Compton interaction permits successful results for the different kinds of samples as well as different sample conditions. (M.C.G.)

42586 (CEA-R-3348) DETERMINATION OF TRITIUM BY COUNTING. Schott, Roger; Froment, Gerard; Pinson, Jean; Genty, Claude (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). Feb. 1968. 29p. (In French). Dep.

Ionization chamber assay of tritium in any gaseous mixture is a simple, fast, and accurate method. The method of relative determination by comparison to a standard was used rather than the method of absolute assay. The efficiency of the chamber was studied in relation to the pressure inside the chamber and its total volume. The calibration was linear in the range studied (1 to 80 mcc). The reproducibility of the method is good: 13 runs gave a coefficient of variation of 1.6%. The relative accuracy was found equal to ±1.3%. The equipment and techniques are described. (auth)

42587 (DP-1157) AMERICIUM, CURIUM, AND PLUTONIUM YIELDS IN SRP HIGH FLUX IRRADIATIONS. Banick, C. J. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). July 1968. Contract AT(07-1)-1. 7p. Dep. CFSTI.

Analyses of sections of four ^{242}PuO$_2$ targets irradiated at high flux in SRP reactors indicated that the ^{244}Cm and ^{245}Cm yields are near equilibrium between exposures of 5×10^{22} n/cm^2 and 9×10^{22} n/cm^2. High fission losses reduce yields of higher mass isotopes at these exposures. The yields of ^{246}Cm, ^{247}Cm, and ^{248}Cm are still increasing at 9×10^{22} n/cm^2. Fission products correspond to the consumption of ~29% of the initial plutonium after an exposure of 9×10^{22} n/cm^2. (auth)

42588 (IN-1207) BURNUP DETERMINATION OF NUCLEAR FUELS. Project Report for the Quarter October 1-December 31, 1967. Lisman, Frederick L.; Maeck, William J.; Rein, James E. (eds.) (Idaho Nuclear Corp., Idaho Falls). July 1968. Contract AT(10-1)-1230. 18p. Dep. CFSTI.

In a program to develop methods for the accurate determination of the burnup of nuclear fuels, the fast-fission yields of many stable and long-lived fission products from ^{235}U in an EBR-I MARK III fuel rod were measured. The main measurement technique was isotope dilution mass spectrometry. Fast-fission yields relative to ^{148}Nd were determined for: ^{83}Kr, ^{84}Kr, ^{85}Kr, ^{85}Rb, ^{86}Kr, ^{87}Rb, ^{88}Sr, ^{90}Sr, ^{99}Tc, ^{101}Ru, ^{102}Ru, ^{104}Ru, ^{111}Cd, ^{112}Cd, ^{113}Cd, ^{114}Cd, ^{116}Cd, ^{131}Xe, ^{132}Xe, ^{133}Cs, ^{134}Xe, ^{135}Cs, ^{136}Xe, ^{137}Cs, ^{138}Ba, ^{140}Ce, ^{142}Ce, ^{143}Nd, ^{144}Nd, ^{144}Ce, ^{145}Nd, ^{146}Nd, ^{148}Nd, ^{149}Sm, ^{150}Nd, ^{151}Sm, ^{152}Sm, and ^{154}Sm. (M.C.G.)

42589 (JUL-517-RW) DIE SAUERSTOFF- UND STICKSTOFFBESTIMMUNG IN CARBIDEN UND NITRIDEN DES URANS UND EINIGER UEBERGANGSMETALLE. (Oxygen and Nitrogen Determination in Carbides and Nitrides of Uranium and Several Transition Metals). Johannes Rottmann, C. L. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe). Feb. 1968. 116p. (In German). Dep.

Comparative studies were made on the determination of oxygen in uranium carbides by the hot extraction method both under vacuum and with the help of the carrier gas method. The vacuum method was superior to the carrier gas method. Of the bath metals investigated, iron, cobalt, and nickel, cobalt temperatures of 1900 and 2000°C gave the best results. An oxygen determination method carried out by a bath-free hot extraction method in nitrogen current was reported. The nitrogen serves not only as a carrier gas but as a reaction partner in the formation of stable nitrides or carbonitrides. Only uranium carbides with the composition UC_{1+x} could be analyzed by this method. The method is not limited, however, just to the analysis of uranium compounds. All elements whose oxides react with carbon in nitrogen currents to form nitrides or carbonitrides and CO can be analyzed with this method. These include Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, and W. The determination of nitrogen content in ceramic uranium compounds was discussed. The application of the modified Dumas method to the nitrides of Ti, Zr, V, Nb, Ta, Cr, Mo, W, and Fe was proven. (J.S.R.)

42590 (NP-17410) BIBLIOGRAPHY ON APPLICATIONS OF REVERSED-PHASE PARTITION CHROMATOGRAPHY TO INORGANIC CHEMISTRY AND ANALYSIS. Eschrich, H.; Drent, W. (European Company for the Chemical Processing of Irradiated Fuels, Mol (Belgium)). Nov. 1967. 101p. (ETR-211). Dep.

One hundred and ninety-six references, with abstracts, are given. The publications cover the work through June 30, 1967. A survey of experimentally important data is attached in the form of a table. Subject and author indexes are included. (M.C.G.)

42591 (NSJ-tr-129) STUDIES ON RADIOACTIVE X- AND GAMMA-RAY SOURCES APPLIED TO THE DETERMINATION OF ASH CONTENT OF COAL. Tanemura, Takashi; Suita, Hiroshi. Translated from Oyo Butsuri, 36: 444-51(June 1967). 9p. Dep.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 41164. (M.C.G.)

42592 (NYO-2174-74) A FLEXIBLE COMPUTER PROGRAM FOR EVALUATION OF EMISSION SPECTROMETRIC DATA. Reference No. 68-26. Thompson, Geoffrey; Manheim, Frank T.; Paine, Kay (Woods Hole Oceanographic Institution, Mass.). Apr. 1968. Contracts AT(30-1)-2174; AT(30-1)-3010. 95p. (NYO-3010-23). Dep. CFSTI.

A single program was developed, for use with a direct-reading emission spectrometer, to include the following functions for a variety of sample types, excitation methods, and analytical concentration ranges: background correction by linear relation of background at analytical lines to background at other wavelengths; use of background, internal standard, and analytical channels interchangeably; use of either standard dilution or variable composition standards; and standard curve fitting by least squares regression. Curves as high as 6th order can be fitted in order to utilize shoulder and toe areas of these analytical curves without distorting straight-line segments. Corrected sample readout is used as the dependent variable with the coefficients of the standard curve in solving the equation for the unknown concentration. Weak points in the present scheme include sensitivity of the analytical curves to one or a few points which may be greatly in error, for example due to a stenographic mistake; it produces occasional solutions that require that a choice be made. (auth)

42593 (RT/ING-(67)7) NONDESTRUCTIVE METHOD FOR THE DETERMINATION OF THE RATIO O/U IN SINTERED DISCS. Ferro, C.; Moretti, S.; Patimo, C. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1967. 17p. (In Italian). Dep.

A method is described for the nondestructive determination of O/U ratio in UO_2 ceramic fuels. For this purpose, e.m.f. measurements of solid electrolyte cells have been exploited. Two types of cells have been used: Cu, Cu_2O/ZrO_2; CaO/Ni, NiO and Ni, NiO/ZrO_2; CaO/UO_{2+x} and emf measurements as a function of temperature have been performed. The former has been used for the calibration of the Ni, NiO reference electrode. The latter has been used to measure the molar partial free energy of oxygen in equilibrium with UO_{2+x}. Finally, the best temperature range, in which the measurements are more reproducible (750°C + 850°C); has also been determined. (auth)

42594 (TEES-2671-6) INVESTIGATIONS IN AUTOMATED ACTIVATION ANALYSIS. Menon, M. P. (Texas Agricultural and Mechanical Univ., College Station. Activation Analysis Research Lab.). Mar. 15, 1968. Contract AT(40-1)-2671. 48p. Dep. CFSTI.

Optimum conditions for irradiation and counting of agricultural crop samples for the measurement of their bromine pesticide content, in the limit-of-sensitivity range, are discussed. Different mathematical procedures for the analysis of the spectral data obtained from NaI(Tl) spectrometer and the use of Ge(Li) detector and $\gamma-\gamma$ coincidence counting system as alternate counting devices for the analysis of traces of bromine are also described. The precision and accuracy in the results of the analysis have been checked by a comparison of the values obtained from various methods. (auth)

42595 (UJV-1978) DETERMINATION OF RADIOCERIUM IN FISSION PRODUCTS MIXTURE BY REVERSED PHASE PARTITION CHROMATOGRAPHY WITH DI(2-ETHYLHEXYL)PHOSPHORIC ACID. Krtil, J.; Bezddek, M.; Mencl, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Apr. 1968. 9p. Dep.

The radiocerium(IV) was extracted from $5\underline{M}$ nitric acid and $0.5\underline{M}$ sodium bromate on a column of siliconized kieselguhr CHROMOSORB W saturated with the bis(2-ethylhexyl)ester of phosphoric acid (10% wt). The sorbed cerium was reduced and eluted from the column by a mixture of $5\underline{M}$ HNO_3 + $0.1\underline{M}$ ascorbic acid and then was γ-counted. The interfering influence of the activity of radioruthenium was removed by its transformation to nitro–nitroso ruthenium(III) complexes, which passed through the column. $^{95}Zr-^{95}Nb$, which was also sorbed with cerium on the column, was not eluted by $5\underline{M}$ HNO_3 + $0.1\underline{M}$ ascorbic acid. The yield of isolation of radiocerium was >99.5% and the total accuracy of its determination was ±1.5% relatively. (auth)

42596 POLAROGRAPHIC DETERMINATION OF LOW AND EXTREMELY LOW URANIUM CONTENT IN ORES. Chao, Tsao-fan; Yang, Ch'i; Tai, Kuo-chung. Wu Han Ta Hsueh Tzu Jan K'o Hsueh Hsueh Pao Hua Hsueh Chuan Hao, No. 2, 20-30(Feb. 1960). (In Chinese).

A low U content in ores may be determined by the volumetric method, the colorimetric method, or the polarographic method, but if the content is extremely low, only the radiation analysis method, the fluorescent method, or the polarographic method may be used. With the radiation analysis method, special instruments are required. With the fluorescent method only a semiquantitative result may be obtained in ordinary laboratories. Thus, the polarographic method utilizing the nitrate catalytic wave is very valuable. A technique is reported for combining ordinary polarography and nitrate catalytic wave polarography to determine 0.00001 to 5% content of uranium in ores very accurately. (JPRS)

42597 SPECTROPHOTOMETRIC DETERMINATION OF DYSPROSIUM, HOLMIUM, ERBIUM, THULIUM, AND YTTERBIUM. Lu, Kuo-i; Chi, Yung-i. Chung Kuo K'o Hsueh Yuan Ying Yung Hua Hsueh Yen Chiu So Chi K'an, No. 12, 17-21(Oct. 1964). (In Chinese).

The gram-molecular extinction coefficients and correction factors due to interfering elements were established for the rare earths Dy, Ho, Er, Tm, and Yb by means of a Cϕ-4 model spectrophotometer. Through the experimentally established stability of the absorption spectra of Er, Tm, and Yb chlorides it was shown that chlorides of rare earths of the yttrium group should yield stable absorption spectra. The accuracy of spectrophotometric titrations for the elements Dy, Ho, Er, Tm, and Yb was established at ±2% with solutions of the pure rare earth halides of known composition. (JPRS)

42598 DETERMINATION OF ^{90}Sr IN SEDIMENT AND SOIL BY EXTRACTION WITH TRIBUTYL PHOSPHATE. Stradomskii, V. B.; Goncharova, S. N. Gidrokhim. Mater., 41: 28-32(1966). (In Russian).

^{90}Sr can be determined in the presence of its daughter ^{90}Y by extraction of the ^{90}Y with TBP. 200 g of sample plus 0.1 g of carrier Sr is treated with 6 $\underline{N}$ HCl, Fe is precipitated in the solution as $Fe(OH)_3$, and ammonium carbonate is added to the weakly alkaline medium to precipitate $CaCO_3$ and the Sr. The precipitate is dried on a funnel, weighed, and left to allow the ^{90}Y to accumulate. The yield of ^{90}Sr is determined from the yield of carrier. The precipitate is then dissolved in 12 $\underline{N}$ HNO_3 (12 ml for each g of $CaCO_3$), 15 mg of Y is added as carrier, and the Y is extracted by 3 equilibrations with TBP. The combined extracts are washed with concentrated HNO_3 and with saturated NH_4NO_3 solution, and the Y is re-extracted into hot H_2O. The $Y(OH)_3$ is precipitated from the aqueous solution, ignited to Y_2O_3, and the yield of Y based on the carrier and the radioactivity of the precipitate is determined. The yield of ^{90}Y based on the carrier is 95 to 98%. (Anal. Abstr.)

42599 IMPROVEMENTS RELATING TO THE ANALYSIS OF UNKNOWN MATERIAL. (to Kaman Aircraft Corp.). British Patent 1,117,919. June 26, 1968. Priority date Dec. 9, 1964, United States.

A method of quantitative analysis by activation comprises the steps of simultaneously irradiating a number of samples of material with high-energy particles. At least one of the samples contains an unknown amount of a transmutable material to be determined, and at least one other of the samples is a reference standard containing a known amount of the material. During irradiation, the samples are moved simultaneously along a common path with respect to the source of the nuclear particles so as to produce substantially uniform irradiation of the samples. The samples are then transferred in a predetermined time sequence to radiation detection means, and the radiation from each sample is counted individually over a predetermined time interval. The apparatus for carrying out the analysis is described. (B.L.M.)

42600 CATHODE-RAY POLAROGRAPHIC DETERMINATION OF TRACE ELEMENTS IN TIN CHLORIDES. Naumann, R.; Schmidt, W. (Kontroll-Laboratorium, Darmstadt, Ger.). Z. Anal. Chem., 239: 1-6(1968). (In German).

A method is described for the cathode-ray polarographic determination of traces of Ni, Pb, Mu, Co, Cu, Fe, and Mo in tin chlorides. Tin is separated from the trace metals by ion exchange on the strong basic anion-exchange resin AG 1X8. The detection limits are within the ranges of 10^{-4}% and 10^{-5}%. (auth)

42601 PAPER-CHROMATOGRAPHIC SEPARATION OF ALKALINE-EARTH METALS. Zimina, N. M.; Verezhnikova, N. S.; Berestneva, T. I. Tr. Lab. Ionoobmen. Protessov Sorbtsii, Nauch.-Issled. Fiz.-Khim. Inst. Voronezh., 1: 55-9(1967). (In Russian).

Chromatographic separation is achieved by placing 0.01 ml of a HCl solution containing ≯10 μg each of Ba, Ca, Sr, and Mg, at a distance of 3 cm from the end of the paper strip (35 cm × 2.5 cm), drying at 40 to 50°C, and subjecting the strip to ascending chromatography for 6 hr at 18 to 20°C with pyridine – ethanol – 1.5 N acetic acid (2 : 2 : 1) as solvent. The chromatogram is dried, and the spots revealed by spraying with saturated Na rhodizonate solution for Ba and Sr or 1% ethanolic alizarin or diphenylcarbazide followed by treatment with NH_3 vapor for Ca and Mg, respectively. Under these conditions good separation of mixtures is obtained with the following minimum contents of elements (the limiting dilution is given in parenthesis) –Mg, 1.2 μg (1 in 7000); Ca and Sr, 0.06 μg (1 in 15,000); and Ba, 0.02 μg (1 in 50,000). The corresponding R_f values in the same order are 0.72 to 0.80, 0.46 to 0.50, 0.23 to 0.25, and 0.07 to 0.09. In the concentration ranges indicated, the R_f value is independent of concentration. Clear separation of the spots is also obtained in chromatography of mixtures of Ba and Sr in ratios of 1 : 40 to 25 : 1 by weight. (Anal. Abstr.)

42602 DETERMINATION OF COPPER IN FATS BY NEUTRON ACTIVATION ANALYSIS. Hirai, Hisao (Miyoshi Oil and Fat Co., Ltd., Japan). Yukagaka, 17: 72-7(Feb. 1968). (In Japanese).

A neutron activation method is proposed for determination of trace quantity of Cu, down to submicrogram level, in fats. The sample and standard are irradiated for 5 hr at a neutron flux of 1.7×10^{12} $n \cdot cm^{-2} \cdot sec^{-1}$. The radiochemical separation consists of extraction of the induced activity ^{64}Cu in HCl from toluene solution of the irradiated fat, followed by the anion exchange in HCl media. The activity is finally mounted as copper (II) sulfide. The activity measurement is taken on a NaI (Tl) crystal coupled with a 256 channel pulse height analyzer. Radiochemical purity is satisfactory. The chemical yield averages 79.6%, and there is a considerable saving of time in the radiochemical work. The agreement is good for determinations of trace Cu, by a colorimetric method preceded by dry ashing along with magnesium nitrate as an ashing aid, and by the neutron activation method. (NSA of Japan)

42603 SOLVENT EXTRACTION AND SPECTROPHOTOMETRIC DETERMINATION OF THORIUM(IV) WITH METHYLTHYMOL BLUE. Otomo, Makoto (Hachinohe Tech. Coll, Japan). Nippon Kagaku Zasshi, 89: 503-6(May 1968). (In Japanese).

A method is proposed for the spectrophotometric determination of Th(IV), which is based on the extraction of Th(IV)-methylthymol blue(MTB) chelate into 1-butanol in the presence of 1,3-diphenylguanidine(DPG). The blue chelate extracted in the organic phase has an absorption maximum at 590 mμ. The maximum and the constant extraction is obtained when the pH of the aqueous phase is controlled to 2.5 to 3.0. A good linear relationship between the absorbance of the organic phase and the concentration of Th(IV) is obtained in the concentration range from 3 to 30 μg per 20 ml. The molar extinction coefficient of the extracted chelate is about 66000 at 590 mμ, and the sensitivity of the reaction is 0.0036 $\mu g/cm^2$ for $\log I_0/I = 0.001$. The composition of the extracted species is deduced by a spectrophotometric technique to be $[Th(MTB)_2]^{4-} \cdot [(DPG)]_4^+$. (NSA of Japan)

42604 DETERMINATION OF TUNGSTEN(VI) IN TUNGSTATE SOLUTION BY ELECTROMETRIC TITRATION. Gupta, C. M. (Univ. of Rajasthan, Jaipur, India). J. Proc. Inst. Chem. (India), 38: 211-14(1966).

It was shown that the quantitative precipitation of W as $PbWO_4$ provides a simple, rapid, and accurate method for the conductimetric, amperometric, and potentiometric (with a W electrode) determination of W in tungstate solution with a concentration as low as 10^{-4} M. High concentration of neutral salts and complex-forming substances (e.g., acetate, tartrate, oxalate, citrate, and phosphate); cations that form insoluble tungstates (e.g., Ag, Cd, Ce, Th, and Hg); and anions that react with Pb (e.g., MoO_4^{2-} and CrO_4^{2-}) interfere. The pH must be within the range 6.5 to 7.5. (Anal. Abstr.)

42605 SPECTROPHOTOMETRIC STUDY ON THE ACETATE COMPLEXES OF THE RARE EARTHS. Lu, Kuo-i; Chi, Yung-i. Chung Kuo K'o Hsueh Yuan Ying Yung Hua Hsueh Yen Chiu So Chi K'an, No. 12, 12-16(Oct. 1964). (In Chinese).

The maximum absorption wave-length and the molecular extinction coefficients of the acetate complexes of Pr, Nd, Sm, Dy, Ho, Er, Tm and Yb were studied. Correction factors for interfering elements, absorption peaks, and limiting wave lengths were studied and compared with the data on the chlorides to determine the optimum amount of ammonium acetate to be used. The stability of rare earth acetate complexes was also studied. Experiments also indicated that acetate complexes can be used to determine the spectra of single rare earth elements and that certain bands of certain elements have the quality of increasing the sensitivity and lower the effect of interfering elements. (JPRS)

42606 DETERMINATION OF URANIUM CONTENT IN ORES WITH ION-EXCHANGE COLORIMETRY. Ch'en, Chia-R'o; Hsieh, Ko-po; Chao, P'ei-ching. Wu Han Ta Hsueh Tzu Jan K'o Hsueh Hsueh Pao Hua Hsueh Chuan Hao, No. 2, 31-5(Feb. 1960). (In Chinese).

A method is reported for direct utilization of morin to determine the U content of ores, after the ion exchange method is used to isolate the interfering ions. A medium of 0.3M HNO_3 – 1.6M $Al(NO_3)_3$ is used for the exchange, and the Zerolitff strong alkali positive ion exchange resin is used as the exchange agent. This technique can basically separate all contents of ordinary ores that interfere with colorimetric determination. After the exchange process, morin is used for colorimetric determination in an ammonium acetate buffer solution with a pH of 9.5 to 10. This method may be used to analyze ores containing 0.05 to 0.8 mg of uranium. (JPRS)

42607 MASS-SPECTROMETRIC ANALYSIS OF ^{10}B IN BIOLOGICAL PREPARATIONS. THERMOIONIC EMISSION METHOD. Yu, Ch'ung-piao; Li, Yu-kung; Liu, Tung-lai; Liu, Tse-yin; Ling, Ming-te. Yuan Tzu Neng, No. 8, 691-5(1965). (In Chinese).

Samples were dried until the weight remained constant and then ground up; quantities that the B content would be ~0.5 mg, and no less than 0.2 mg were selected. A small quantity of $Ca(OH)_2$ was added to the crucible and this was heated at 550° until a homogenous white mass was obtained which was dissolved in 0.36N H_2SO_4. The solution was filtered and a small quantity of concentrated H_2SO_4 was added to the filtrate, this was evaporated until the appearance of a white vapor. After cooling, 20 ml of CH_3OH were added in small portions; this was followed by heating until the appearance of a white vapor and was repeated four times. In the process, H_3BO_3 was completely transformed into $B(OCH_3)_3$. The latter, in the vapor state, is absorbed by Na_2CO_3, with the formation of $Na_2B_4O_7$, which when heated, yields $Na_2BO_2^+$. Analyses were performed by using the MI-1305 mass spectrometer (voltage of 4 kv, temperature of 800°). The peak thermionic emission (~3v) occurred after 30 min; however, ion emission continued even after 150 min, although with considerably lower intensity. The accuracy of this method in comparison with calculations turned out to be ±1.1%. (JPRS)

42608 POSSIBILITIES OF THE DETERMINATION OF THE ISOTOPE EFFECTS OF ^{40}K BY RADIOMETRIC METHODS. Zaduban, M.; Seidel, H. O. (Safarik Univ., Kosice, Czechoslovakia). Mikrochim. Acta, No. 4, 699-704(1968). (In German).

The possibility is shown of determining deviations in the quantity of ^{40}K by radiometric methods, a matter of special significance in activity measurements of samples of biological origin. The isotope effect of ^{40}K is best determined by β measurements with the aid of a gas flow counter in the $2\text{-}\pi$ geometry or by means of a plastic scintillator. (auth)

42609 INVESTIGATIONS ON MORPHOLINE-N-DITHIOCARBOXYLIC ACID MORPHOLINIUM AS REAGENT IN QUANTITATIVE ANALYSIS. V. RAPID DETERMINATION OF MOLYBDENUM IN HIGH-ALLOY STEEL. Likussar, W.; Beyer, W.; Wawschinek, O. (Univ., Graz). Mikrochim. Acta, No. 4, 735-8(1968). (In German).

The reaction of morpholine-N-dithiocarboxylic acid morpholinium with molybdenum is suitable for spectrophotometric determination of small quantities of molybdenum. The determination limits and the molar extinction coefficient are given. A procedure for the rapid determination of molybdenum in highly alloyed steels is stated. This method was tested on five control samples. (auth)

42610 THE APPLICATION OF LOW-ENERGY (20 TO 610 keV) γ SPECTROMETRY TO THE DETERMINATION OF SOME RADIOACTIVE MINERALS. Charlet, J.-M. (Faculte Polytechnique, Mons, Belg.). Bull. Soc. Fr. Miner. Crist., 91: 151-65 (Mar.-Apr. 1968). (In French).

Gamma spectral analysis of several radioactive minerals was performed using a 400 channel analyzer with a classic scintillation crystal or a Ge/Li detector. The experimental variables were studied (thickness of the sample, grinding effect, statistical error, etc.) and the effects of various parameters on the γ spectra are specified in this paper (radioactive equilibrium, variation of the mass-absorption coefficient, photoelectric absorption, scattering process, fluorescent radiation of the elements with a high atomic number, etc.). The study by γ spectrometry of some ten secondary uranium minerals and some metamict minerals provides a method for the determination of radioactive raw materials. This method is based on the differential absorption of the γ photons in the low-energy range. (auth)

42611 GAMMA RAY SPECTRA AND SENSITIVITIES FOR 14-MeV NEUTRON ACTIVATION ANALYSIS. Cuypers, M.; Cuypers, J. (Texas A and M Univ., College Station). J. Radioanal. Chem., 1: 243-64(May 1968).

A study was made to define experimentally the sensitivity of determination for 63 different elements by 14-MeV neutron activation, with a 150 kV Cockcroft-Walton accelerator at a neutron flux of 2×10^8 n $\cdot$ cm$^{-2} \cdot$ sec^{-1} on the sample. The obtained gamma-ray spectra are given, and the origin of the photopeaks observed are explained. A maximum irradiation time of five minutes was used as a convenient experimental limit to obtain the maximum sensitivity, considering, however, that the tritium target life is limited, and that the time to perform an analysis has to be reasonable. The practical use of 14-MeV neutron activation analysis is demonstrated by the detection limits obtained. (auth)

42612 DETERMINATION OF CARBON, NITROGEN, AND OXYGEN IN GASES BY NEUTRON TIME-OF-FLIGHT SPECTROMETRY. Naude, W. J.; Peisach, M.; Pretorius, R.; Strebel, P. J. (Southern Universities Nuclear Inst., Faure, South Africa). J. Radioanal. Chem., 1: 231-41(May 1968).

Carbon, nitrogen, and oxygen were determined in gases by time-of-flight spectrometry of prompt neutrons from the respective reactions $^{12}C(d,n)^{13}N$, $^{14}N(d,n)^{15}O$ and $^{16}O(d,n)^{17}F$, produced by a pulsed beam of deuterons of 2 MeV (for nitrogen) or 3 MeV. The analysis is nondestructive and requires about 15 min. per sample. The relative standard deviation for all three elements was about ±3%. Detection limits, using a total irradiation current of 20 millicoulombs, for carbon, nitrogen, and oxygen, respectively, were 6×10^{-8} g, 2×10^{-7} g and 1.7×10^{-7} g per cm^2 cross-sectional area of irradiating beam. (auth)

42613 INFLUENCE OF THE ENERGY OF PRIMARY RADIATION ON THE SENSITIVITY OF X-RAY FLUORESCENCE ANALYSIS. Lubecki, A.; Wasilewska, M. (Inst. of Nuclear Techniques, Krakow). J. Radioanal. Chem., 1: 211-18(May 1968).

Theoretical considerations and experimental data are presented concerning the influence of the energy of the primary radiation on the sensitivity of x-ray fluorescence analysis. An additional criterion in selecting the energy of the primary radiation based on the relative sensitivity of x-ray fluorescence analysis depends on the energy of the primary radiation and it becomes higher with the increase of this energy. (auth)

42614 DETERMINATION OF SOME IMPURITIES IN GALLIUM BY NEUTRON ACTIVATION. Krivanek, M.; Kukula, F.; Vins, V. (Inst. of Nuclear Research, Rez, Czechoslovakia). J. Radioanal. Chem., 1: 219-24(May 1968). (In French).

Neutron activation is suggested for the determination of Pt, Au, Hg, Sc, Zn, and Sn in high purity gallium. Pt, Hg, and Au are reduced to metals, gallium is extracted and then Sc, Zn, and Sn are separated on Dowex 1 × 8 ion exchanger. All components except Sn are determined by substoichiometric methods in the form of chelate complexes. Sn is extracted with oxine into chloroform, and the chemical yield measured by spectrophotometry. (auth)

42615 MASS SPECTROGRAPHIC TECHNIQUE FOR THE DETERMINATION OF MOLYBDENUM ADDITIVE IN TANTALUM OXIDE CAPACITOR FILMS. Malm, D. L. (Bell Telephone Labs., Inc., Murray Hill, N. J.). Appl. Spectrosc., 22: 318-20(July-Aug. 1968).

Recent analytical demands in thin-film technology require a means for quantitative measurements of intentionally added impurities in sputtered tantalum capacitor films. The inherent high sensitivity and surface-sensing ability of the rf vacuum spark source mass spectrograph suggest its usefulness for this study. It was demonstrated that with the aid of an internal standard and a sample-scanning technique that samples the film on the substrate, thus eliminating any chemical separations, quantitative estimates of molybdenum additive in films 4000 Å thick can be made with an average deviation of ±23%. A concentration range of 0.02% to 3.1% atomic fraction of molybdenum in tantalum films was studied. Because adequate sensitivity is attained without consuming the entire available sample, it is reasonable to predict that sensitivities of 10 ppM atomic or less may be reached. Results show a linear increase in the molybdenum concentration as the molybdenum-to-tantalum sputtering-surface ratio increases. Once this relationship has been established, films with the desired molybdenum concentration can be produced without the need for further chemical analysis. Mass spectrographic results also indicate that the molybdenum additive is homogeneously distributed in the tantalum film. (auth)

42616 X-RAY DETERMINATION OF CERIUM IN NODULAR IRON. Cohen, S.; Bryan, F. R. (Ford Motor Co., Dearborn, Mich.). Appl. Spectrosc., 22: 342-3(July-Aug. 1968).

The use of x-ray fluorescence for the determination of cerium in nodular cast iron, sampled both as disks and drillings, was investigated. The calibration curve, resulting from plotting counts against cerium concentration, appeared to be perfectly linear and appropriate for use from 0.01 to 0.10% cerium. When samples were analyzed both chemically and by x-ray fluorescence, the results obtained were consistent to a degree approaching the precision of the methods. (D.H.M.)

42617 NATURE OF THE EXPERIMENTAL MOHOLE BASALT: REDETERMINATION OF LANTHANIDES. Masuda, Akimasa (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 73: 5425-8(Aug. 15, 1968).

Rare earths (lanthanides) in the experimental Mohole basalt were determined accurately by an isotope dilution method in order to check a dispute between L. A. Haskin and F. A. Frey (1966) and J. F. Lovering and J. W. Morgan (1966) on the nature of this rock. The result shows that it is possible to conclude that a separation as a solid phase system from an equilibrated liquid is involved in the development of this basalt. It is also possible that the uranium and thorium contents determined by Morgan and Lovering are in line with lanthanide results. (auth)

42618 POTASSIUM: ARGON PROBLEM IN IRON METEORITES. Rancitelli, Louis A. (Cornell Univ., Ithaca, N. Y.); Fisher, David E. J. Geophys. Res., 73: 5429-37(Aug. 15, 1968).

The ^{41}K and ^{40}Ar contents of the metal phase of several iron meteorites, using activation analysis, were measured and ages of 0 to 15×10^9 years were obtained. Shocked and unshocked specimens of Canyon Diablo showed no differences in Ar content or K : Ar age. The K in the metal phase was located primarily along grain boundaries and was easily leached out by water. It was concluded that ages previously measured by this technique were invalid in that they reflect mainly K loss by terrestrial water rather than an event in the meteorites formation. (auth)

42619 ASSESSMENT OF NEUTRON CAPTURE γ-RAY ANALYSIS. Garbrah, B. W.; Whitley, J. E. (Scottish Research Reactor Centre, Glasgow). Int. J. Appl. Radiat. Isotop., 19: 605-14 (Aug. 1968).

Analysis by the measurement of thermal neutron capture gamma rays is described, and the technique compared with other nondestructive nuclear methods for elements of interest. The accuracy attainable in the analysis of practical samples was examined and shown to be strongly dependent on the extent of matrix interferences. In favorable cases an accuracy of ±1% is attainable. The sensitivity of the technique is limited by the neutron absorption cross section of the element of interest. With the apparatus described, boron and rare earths can be determined in trace quantities, whilst hydrogen can only be determined in the percentage range. (auth) (UK)

42620 DETERMINATION OF GOLD IN ORES AND SOLUTIONS BY ACTIVATION ANALYSIS WITH A NEUTRON GENERATOR. Uken, E.-A. (National Inst. for Metallurgy, Johannesburg); Watterson, J. I. W.; Knight, A.; Sellschop, J. P. F. Int. J. Appl. Radiat. Isotop., 19: 615-23(Aug. 1968).

There is a continuing need for more sensitive and more rapid techniques for the direct determination of gold in solutions and in the ore bodies of the Witwatersrand series in South Africa. Neutron activation analysis was investigated with a small accelerator type of neutron generator yielding 14-MeV and thermal neutrons. The results indicated that only in special circumstances does this technique offer any advantages over the conventional assay methods. (auth) (UK)

42621 COLORIMETRIC DETERMINATION OF MOLYBDENUM IN SOILS AND SEDIMENTS BY ZINC DITHIOL. Stanton, R. E.; Hardwick, A. J. (Imperial Coll. of Science and Tech., London). Analyst, 92: 387-90(June 1967).

A method is presented for determining molybdenum in soils, sediments, and rocks. The sample is decomposed by fusion with potassium hydrogen sulfate and the molybdenum is taken into solution with hydrochloric acid. Interference by iron is prevented by reduction to the iron(II) state and reaction with copper by adding potassium iodide. Tungsten interference is suppressed by careful control of the time allowed for complex formation. The molybdenum–dithiol complex is extracted into light petroleum and determined either by visual comparison or spectrophotometry. (auth) (UK)

42622 RADIOCHEMICAL METHODS OF ENZYME ASSAY. Oldham, K. G. RCC Review No. 9. Amersham, Eng., Radiochemical Centre (UKAEA), 1968. 48p.

A critical examination is presented of the present uses and potential of radiochemical methods of enzyme assay, together with a bibliography (180 references) of published work in this field. The various techniques which have been employed are discussed, examples are given from each class of enzyme, and important factors in assays of enzymatic activity are reviewed. (UK)

42623 COMPARISON OF METAL BATH TECHNIQUES IN VACUUM FUSION ANALYSIS BY AN ISOTOPE DILUTION METHOD. Kamada, Hitoshi; Furuya, Keiichi (Tokyo Univ.). Bull. Chem. Soc. Jap., 41: 1256-8(May 1968).

An isotope dilution method using ^{18}O-labeled carbon monoxide was used in the determination of oxygen in a high manganese steel without the bath technique and with iron, platinum, and tin bath techniques. The results of the isotope dilution method and the data obtained for the ^{18}O concentration of the residual gas indicate that the platinum and iron baths can promote reaction between carbon and oxygen in a melt. The tin bath can effectively prevent the adsorption of carbon monoxide in the furnace, and does not promote the reaction in a flux. It is thus desirable to use a combination bath, one containing a metal that promotes reaction in the flux, and also a metal that prevents the absorption of carbon monoxide in the furnace. (D.H.M.)

42624 SPECTROGRAPHIC DETERMINATION OF IMPURITIES IN RADIOACTIVE SUBSTANCES USING PULSE ELECTRICAL ARC IN THE ARGON ATMOSPHERE. Svoboda, Vratislav; Kleinmann, Imrich (Inst. of Research, Production, and Application of Radioisotopes, Prague). Jad. Energ., 14: 193-7 (May 1968). (In Czech).

A highly sensitive spectrographic method for analysis of radioactive materials was developed. The solution is evaporated on surface of a polystyrene-impregnated graphite electrode and the evaporation residue is excited in an argon atmosphere by a 60-amp discharge current. A discharge chamber for automatic analysis of 24 samples was constructed. The discharge chamber is vacuum sealed and the electrodes are surrounded by quartz tubes of about 10 mm id. The chamber is refilled in the active area and during the excitation in a spectrographic laboratory it may be handled as a closed source. The discharge chamber is electrically interconnected with power source and spectrograph; the fully automatic arcing of 24 samples takes 6 min. The limits of detection of described method are compared with copper spark method. (auth)

42625 STUDIES OF SORPTION OF RARE-EARTH ELEMENTS AND URANIUM ON PHOSPHORUS CONTAINING RESIN CATIONS. Miklishanskii, A. Z.; Yakovlev, Yu. V.; Dogadkin, N. N.; Leikin, Yu. A.; Davankov, A. B. (Inst. of Geochemistry and Analytical Chemistry, Moscow. Moscow Inst. of Chemistry and Tech.). Izv. Akad. Nauk SSSR, Ser. Khim., No. 7, 1457-61(July 1968). (In Russian).

Distribution coefficients for rare earths (^{152,154}Eu, ^{160}Tb, ^{166}Ho, ^{169,175}Yb and ^{177}Lu) and uranium were determined as functions of the HCl concentration. Experiments were made with 50 mg H$^+$ sorbent shaken for 24 hr with 20 ml of various concentrations of HCl solutions in the presence of respective rare earth isotopes. The distribution coefficient K_r was determined by the difference in the activity before and after sorption. Photometric determination of uranium K_r was achieved using arsenazo III. (R.V.J.)

42626 SEPARATION OF URANIUM WITH USE OF CARBONATE. EFFECT OF THORIUM HYDROXIDE DESORBENT. Upor, E.; Nagy, G. (Mecseki Ercbanyaszati Vallalat, Kovagoszollos, Hungary). Magy. Kem. Foly., 73: 20-5(1967). (In Hungarian).

The separation of U using CO_3^{2-} is incomplete, even in the optimum pH range (9 to 12), because of the sorption of $[UO_2(CO_3)_3]^{4-}$ on the surface of a precipitate of heavy metal hydroxides or phosphates; the addition of Th prevents this sorption and renders the separation quantitative. When a 1-g sample of rock is analyzed for U, the addition of 20 mg of Th is sufficient. The Na_2CO_3 must normally be 0.1$\underline{M}$, or 0.5$\underline{M}$ if $Ca_3(PO_4)_2$ is present. The mechanism of the effect of Th is discussed. (Anal. Abstr.)

42627 INVESTIGATION OF FACTORS AFFECTING ACCURACY AND SENSITIVITY OF THE FLUORIMETRIC DETERMINATION OF URANIUM. Samsoni, Z. (Nuclear Research Inst., Debrecen, Hungary). Mikrochim. Acta, No. 1, 88-97(1967).

The optimum conditions for fluorimetric determination of 0.01 to 10 μg of U are given. The bead material consists of 50 mg of NaF–$NaKCO_3$ (3 : 7); this gives a sufficiently low mp to avoid attack on the Pt crucible, but permits reasonable sensitivity. The bead is electrically heated at 650°C for 10 min, then the oven is switched off, and the bead is allowed to cool slowly. After 2.5 hr, the bead is removed (at 260 to 280°C). Measurement of fluorescence intensity should be made in the next 2 hr for maximum accuracy. The efficiency of the filter (5% $NaNO_2$ soln) in removing unwanted wavelengths and spurious reflections is improved by incorporating 1% of tartrazine. With these modifications, the method gives good reproducibility and has an error of <±10%. (Anal. Abstr.)

42628 TITRATION OF URANIUM(IV) WITH CERIUM(IV) BY USING METHYL ORANGE OR METHYL RED AS INDICATOR. Rao, K. Bhaskara (Madras Aluminium Co., Ltd., Mettur Dam, India). Chem.-Anal., 56: No. 1-2, 28-9(1967).

A method is reported for the titration of 8 to 270 mg of U(IV) in a medium 1.5 $\underline{M}$ $HClO_4$ or 1 $\underline{M}$ HCl at room temperature with 0.1 $\underline{M}$ Ce(IV). Using either methyl orange or methyl red as an indicator, the color change at the endpoint (red to yellow) is sharp. (Anal. Abstr.)

42629 ACTIVATION ANALYSIS FOR TRACES OF GOLD IN URANIUM MINERALS. Sedano, J. A. Galiano; Jimenez, A. Travesi (Junta de Energia Nuclear, Madrid). An. Real Soc. Espan. Fis. Quim. (Madrid)., Ser. B, 62: 1119-28(1966). (In Spanish).

The powdered sample for determination of Au is irradiated for 3 hr in a neutron flux of $\approx 5 \times 10^{11}$ neutrons/cm^2/sec. Carrier Au is added, and the sample is dissolved in aqua regia. Radiochemical separation of the Au is carried out, and its activity is determined by measurement of the total γ activity or by γ spectrometry. Gold foil (0.1 to 0.2 mm thick) is used as a standard. As little as 20 ng of Au can be determined by this method. (Anal. Abstr.)

42630 REVERSED-PHASE CHROMATOGRAPHY OF RARE-EARTH METALS ON PAPER TREATED WITH DIALKYL ORTHOPHOSPHATES. Fisel, S.; Ungurenasu, C.; Grosu, G. (Univ. Al. I. Cuza, Iasi). An. Stiint. Univ. Al. I. Cuza, Sect. I, 12: 153-8 (1966). (In French).

Butyl (or secbutyl or isobutyl) 2-ethylhexyl orthophosphate was used as a 1 to 10m$\underline{M}$ solution in cyclohexane to impregnate S. & S. 2043b paper. The chlorides of La, Ce, Pr, Sm, Eu, Gd, Tb, Ho, Er, Tm, Yb, and Lu (dissolved in 0.1 $\underline{M}$ HCl) were subjected to ascending chromatography on this paper by development for 2 to 4 hr at 20 ± 1°C with HCl (0.05 to 8 $\underline{M}$). The chromatograms were dried, and the metals were located with 1% 8-hydroxyquinoline solution in H_2O–enthanol (1 : 1). Optimum conditions were established for the separation of groups of these metals by the appropriate choice of stationary phase and of HCl concentration. (Anal. Abstr.)

42631 ANALYSIS BY β-RAY BACK-SCATTERING APPLIED TO THE SYSTEM BARIUM CHLORIDE–CALCIUM CHLORIDE. Ralea, R.; Tolea, F.; Cecal, A. (Univ. Al. I. Cuza, Iasi). An. Stiint. Univ. Al. I. Cuza, Sect. I, 12: 143-8(1966). (In Rumanian).

Solutions (5 to 25%) of $BaCl_2$ and $CaCl_2$ and of their mixtures (4 : 1 to 1 : 4, total concentration of 25%) were examined by this technique using the apparatus of Marcu and Murgu (Studia Univ. Babes-Bolyia, Ser. Chem., 1963, 8, 107). The back-scattered β intensity increased in approximate rectilinear correlation with the salt concentration; wholly rectilinear correlations were obtained by applying the equations derived by Ripan et al. (Ibid., 1962, 7, 53). The individual effects of $BaCl_2$ and $CaCl_2$ are different, but are additive, so the mixtures can be analyzed by means of calibration graphs. (Anal. Abstr.)

42632 DETERMINATION OF TRACES OF IRON IN LEAD MOLYBDATE. Gorbenko, F. P.; Enal'eva, L. Ya.; Smirnaya,

V. S. Tr. Vses. Nauch.-Issled. Inst. Khim. Reaktivov, No. 29, 80-3(1966). (In Russian).

For determination of traces of Fe in Pb molybdate, a 3-g sample is dissolved by heating with 100 ml of EDTA tartrate solution. Two ml of a 10% hydroxylammonium chloride solution (free from Fe) and 2 ml of 0.5% 1, 10-phenanthroline (I) solution are added, and the solution is allowed to set for 1 hr. Then, 1 ml of a 12% $NaClO_4$ solution is added, and the $I-Fe^{2+}$ complex is extracted into 25 ml of dichloroethane (II) by shaking for 1 min. The extract is filtered, and the extinction (blue filter) is measured against II. A blank determination is carried out on 100 ml of the EDTA tartrate solution. The error in determining 10^{-4}% of Fe is ≃±15%. (Anal. Abstr.)

42633 INSTRUMENTAL TECHNIQUE FOR MICROANALYSIS BY EMISSION SPECTROSCOPY. **Vogel, Raymond S. (Mallinckrodt Chemical Works, Weldon Spring, Mo.). Meth. Phys. Anal., 131-5(July-Sept. 1967). (In French).**

A microanalyzer was devised for testing areas of <50μm dia. on metallic samples as an accessory for a grating spectrograph of 2 m focal length. A pointed W–Re alloy wire for use as counter-electrode is mounted axially in the 10× objective of a stereoscopic microscope. Two such microscopes are arranged in front of the spectrograph so that both the counter-electrode and sample can be located with a precision of 3 μm. Since the objective system cannot be brought closer than 7 mm from a slit, the latter is removed and the spark-gap is focused on the plate. Sparks 0.5-mm long from a rectified pulsed spark source are produced by a spark-source wired to the microscope objective. The apparatus is useful in identifying the phases of a U–Si–Al alloy, although with lower spatial resolution than is obtainable with an x-ray microprobe analyzer. (B.L.M.)

42634 DETERMINATION OF NATURAL VARIATIONS OF CARBON ISOTOPES IN OIL AND GAS COMPONENTS AND THEIR RELATION TO ORIGIN. **Mueller, Peter; Wienholz, Roland; Maas, I.; Dostal, P.; Geisler, C. Z. Angew. Geol., 13: No. 9, 456-61(1967). (In German).**

A modified method is illustrated for analysis of ^{13}C in geological samples; the variations derive in the chemical treatment of gas and oil samples from the Thuringian basin. General aspects of the technique for evaluation of the genesis of gas and oil deposits are reviewed, particularly with respect to their application to the understanding of migration processes. Preparative gas chromatography for the isolation of methane, ethane, propane, and CO_2 samples is described. Two different groups of methane were found, with different ^{13}C content; this is illustrated as an example of effects of geological migration. Comparison with standard values is noted, the standard chosen being a decane sample. (BBB)

42635 THE DETERMINATION OF LANTHANUM, CERIUM, AND THORIUM WITHOUT SEPARATIONS. Hiiro, Kazuo (Government Industry Research Inst., Osaka); Russell, D. S. Osaka Kogyo Gijutsu Shikensho Kiho, 18: 263-8(July 1967).

A method is proposed for the spectrophotometric determination of small quantities of La, Ce, and Th in the presence of one another without separations. Cerium is estimated from its absorption peak in the ultraviolet region, Th with thorin, and the 3 elements together with arsenazo. The La is calculated after subtraction of the combined absorbances of the arsenazo complexes of the Th and Ce. The procedure can be readily applied to the determination of microgram amounts of the 2 rare earths in Th. In this case the majority of the Th is removed from the solution by solvent extraction with TTA before the estimation of the rare earths. The interference of Fe is considered and proposals made for its removal. (NSA of Japan)

42636 DETERMINATION OF PESTICIDE RESIDUES BY NEUTRON-ACTIVATION ANALYSIS. **Guinn, V. P.; Schmitt, R. A. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Residue Rev., 5: 148-74(1964).**

The basic aspects of activation analysis are discussed in detail, and the experimental procedures of sample preparation, neutron activation, sample treatment after activation, γ spectrometry, and calculation methods are discussed. Tables of ultimate (interference-free) neutron-activation sensitivities of detection, for a typical research-reactor neutron flux, are given. Specific applications of neutron-activation analysis in the pesticide-residue field are discussed. As examples, the results of various investigators for the determination of trace amounts of Br in a wide variety of crops and food stuffs, pesticide-treated and untreated are discussed. The concentrations of total organic Cl in milk butterfat and forage samples can be determined simply and accurately by neutron activation analysis. The various useful types of neutron sources and radiation detection instruments are described in detail. The principal advantages of neutron-activation analysis, as compared with other methods of determining trace element concentrations, are enumerated. (BBB)

42637 COMPLEXOMETRIC DETERMINATION OF CALCIUM IN DRUGS WITH THE AID OF RADIOACTIVE SILVER AS INDICATOR. **Kormicki, Jan; Mikolajek, Ewa (Medical Academy, Krakow). Diss. Pharm. Pharmacol., 20: 87-91(Jan.-Feb. 1968).**

A radiometric method employing ^{110m}Ag for assay of Ca in pharmaceutical preparations is described. The method involves titration with the disodium salt of ethylenediaminetetraacetic acid (EDTA). Radiosilver is used as an indicator because the stability constant for the EDTA-Ag complex is smaller than for complexes of EDTA with other metals. The following Ca compounds were assayed: gluconate, pantothenate, lactate, hydrophosphate, and oxide. The cation Ca^{2+} in the form of the compound CaX is titrated with a solution of the disodium salt of EDTA containing the complexing agent H_2Y^{2-}. The precipitate $^{110m}AgIO_3$ that is insoluble in water is used as an indicator. The anion of the complexing agent Na_2H_2Y reacts primarily only with the cation Ca^{2+} giving a stable complex CaH_2Y, which is soluble in water (stability constants for Ag-EDTA and Ca-EDTA complexes are $pK_1 = 7.3$ and $pK_2 = 10.6$ respectively). The activity of the solution remains constant and depends mainly on the number of $^{110m}Ag^+$ ions present in the solution as result of the solubility and dissociation of $^{110m}AgIO_3$. After the complete removal of Ca^{2+} cations from the solution, the excess of the added complexing agent Na_2H_2Y reacts with the precipate $^{110m}AgIO_3$, giving the soluble complex $^{110m}Ag_2H_2Y$. The radioactivity of the solution increases, being proportional to the amount of the complexing agent added after the equivalence point is reached. (BBB)

42638 INDEX AND BIBLIOGRAPHY OF MASS SPECTROMETRY 1963–1965. McLafferty, F. W.; Pinzelik, John. New York, John Wiley and Sons, Inc., Publishers, 1967. 174p. $12.00.

A review of the literature on mass spectrometry of 1964 and 1965, a bibliography covering the recent mass spectrometry literature on a much broader scope than the review, a keyword-in-context index, and an author index to the bibliography are presented. (D.H.M.)

42639 RADIOACTIVE KRYPTONATES IN VOLUMETRIC ANALYSIS. PART 3. DETERMINATION OF IRON BY RADIOCHELATOMETRIC TITRATION. Toelgyessy, J.; Varga, S.; Jesenak, V. (Slowakische Technische Hochschule, Bratislava). Isotopenpraxis, 4: 223-6(June 1968). (In German).

A method of volumetric analysis was developed for the determination of iron. Chelaton III is used as the titrant solution, and the solid kryptonate of yttrium oxalate $Y_2(C_2O_4)[Kr^{85}]$ as the indicator of end-point. The titration is carried out discontinuously by measuring the activity of radioactive kryptonate. (auth)

42640 (γn) ACTIVATION ANALYSIS OF POLY (VINYL CHLORIDE) SHEET. Azuma, Toshio (Kinki Univ., Fuse, Japan); Sato, Yuji; Tsurugi, Jitso; Miki, Ryota; Kondo, Yoshihide; Yoshida, Joji; Yamamichi, Kunio. Annu. Rep. Radiat. Center Osaka Prefect., 8: 50-4(1967).

Polyvinyl chloride (PVC) sheets and their additive agents are activated, respectively, by the x rays from the ORC Electron Linac. The elements contained in a PVC sheet were estimated from gamma spectra observed. The sensitivity lines for Pb, Cd, and Ba content are reported. (auth)

42641 RUTHENIUM(VIII) CHELATE OF 2,2′-BIPYRIDINE. Ishiyama, Toshio. Annu. Rep. Radiat. Center Osaka Prefect., 8: 40-2(1967).

The structure of the ruthenium(VIII) chelate of 2,2′-bipyridine, formed by reaction of ruthenium tetraoxide with 2,2′-bipyridine in carbon tetrachloride, was investigated, and the composition of the chelate was assumed to be mononuclear, $[RuO_4(C_{10}H_8N_2)] \cdot 3H_2O$. (auth)

42642 (γ,n) ACTIVATION ANALYSIS OF HUMAN BLOOD. Asai, Takuo; Iwai, Yoshiaki; Miki, Ryota; (Kondo, Yoshihide); Sato, Yuji; Azuma, Toshio. Annu. Rep. Radiat. Center. Osaka Prefect., 8: 120-2(1967).

Activation analysis (γ,n) of human blood samples was performed using the ORC Electron Linac. Samples were irradiated with x rays for 60 minutes. The main purpose of this experiment was to find the adequate amount of sample, a containing vessel, and a preparation method. The results obtained show that the thin polyethylene sheet may be useful as a container and 1 cc of blood may be the least possible amount for practical use. Thirteen elements were found by this method, but 4 hours cooling was necessary. (auth)

42643 GAS CHROMATOGRAPHIC RESOLUTION OF GAMMA-RAY SCINTILLATION SPECTRA FOR THE NEUTRON ACTIVATION ANALYSIS OF SHORT-LIVED ISOTOPES. **Cram, S. P. (Univ. of Florida, Gainesville); Brownlee, J. L. Jr. J. Gas. Chromatogr., 6: 305-13(June 1968).**

Gas-liquid chromatography and neutron activation analysis were combined to provide a versatile analytical system capable of high sensitivity, rapid and remote handling of activated samples, short total analysis times, and optimum resolution of multichannel pulse-height spectra. Such spectra are described and demonstrated for chromatographic resolution of the spectral interferences in the multichannel pulse-height analysis of short-lived isotopes. The combined technique provided a quantitative, postirradiation separation to effectively enhance the sensitivity of the activation method by eliminating masking activities, resolving overlapping photopeaks, and removing matrix activities. Complete resolution of pulse-height spectra was realized by using the efficient resolving power and speed of separation of postirradiation gas chromatographic separations. In this manner, the counting efficiency of large volume NaI(Tl) scintillation crystals was not sacrificed for spectral resolution. Further, high speed gas chromatographic separations gave rise to minimal decay losses for short-lived isotopes, and thus the half-life of the isotope could be used to advantage in optimizing the irradiation and decay times to minimize interferences from reactor irradiation. For an organic elemental analysis by thermal neutron activation, only the halogens have favorable isotopic abundances, and (n,γ) products that have decay photons. Therefore, the method is relatively restricted for organic elemental analysis, but at the same time is highly selective. (BBB)

42644 ISOTOPE DILUTION ANALYSIS WITH STABLE ISOTOPES. III. DETERMINATION OF SMALL AMOUNTS OF NITRATE IN PULVERIZED $\alpha-Al_2O_3$. Rolle, Wolfgang; Huebner, Heinrich; Hartenstein, Rolf (Inst. fuer Stabile Isotope, Leipzig). Chem. Tech. (Leipzig), 20: 235(Apr. 1968). (In German).

A method for determination of nitrate in the 100-ppM range in pulverized corundum is described; the accuracy of the method was demonstrated using dilution analysis with ^{15}N. Isotopically enriched HNO_3 (93.7% ^{15}N) was refluxed with alumina; the reaction product was reduced with Devarda's alloy and base to give NH_3, which was absorbed in HCl. The $^{15}NH_4Cl$ produced was dried and oxidized with CuO/Cu to N_2, which was analyzed mass spectrometrically. The results obtained were compared with results obtained by titration. For samples containing about 30 mg NO_3^-/100 g Al_2O_3, the titration results were 1.7 mg higher than the mass spectrometric results, on the average. For practical purposes this difference is insignificant, but the deviation is statistically significant and not understood. The method can be applied to other similar cases. (BBB)

42645 NEUTRON ACTIVATION ANALYSIS AS A QUANTITATIVE ELEMENTAL GAS CHROMATOGRAPHIC DETECTOR. Cram, S. P. (Univ. of Florida, Gainesville); Brownlee, J. L. Jr. J. Gas. Chromatogr., 6: 313-20(June 1968).

Neutron activation analysis by scintillation pulse-height spectrometry was shown to be a highly sensitive and selective detector for elemental analysis in gas-liquid chromatography. Its speed for quantitative analyses was demonstrated by using short-lived isotopes. The activation cross-section, isotopic abundance, half-life, and thermal neutron flux were shown to be the parameters limiting the feasibility of applying the activation method. Neutron activation was shown to be unique in several respects as a chromatographic detector. For the analysis of the organic halides described, its sensitivity is independent of the chemical nature of the column effluent and may be calculated for the effluent(s) of interest in the absence of any spectral interferences. The data interpretation is straight-forward and simplified by the chromatographic clean-up of the pulse-height spectra. This was shown to be quantitatively complete so that the theoretical limit of sensitivity of the method may be realized. (BBB)

42646 INVESTIGATION OF THE ISOTOPIC COMPOSITION OF THE OXYGEN OF NATURAL WATERS BY PRECISION MASS-SPECTROMETRIC ANALYSIS. Vetshtein, V. E. (Inst. of Physical Chemistry, Kiev). Isotopenpraxis, 4: 228-30(June 1968). (In Russian).

The distribution of the ^{18}O isotope in condensate water of different vulcanes of Kamchatka was investigated. The results of these investigations are compared with those of analogous samples from rivers and lakes in eastern Siberia and Kamchatka as well as from the ocean water of the territory of the Kuriles and the Pacific Ocean. Water samples from the Dnieper River near Kiev were employed as standard samples. The results of the comparisons were used for the purpose of geological studies. (auth)

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Refer also to abstracts 42625, 42779, 42786, 42787, 42808, 43159, 43179, 44183, 44238, and 44827.

42647 (AEC-tr-6937, pp 104-8) MASS SPECTRA OF PYRIDINE AND PICOLINES. Tsuji, Kozo (Kyoto Univ.); Hayashi, Koichiro; Okamura, Seizo; Hatada, Motoyoshi; Hirota, Kozo. Translated from Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 8: 97-102(1966-67).

An abstract of this paper, prepared from the original language, appeared as NSA 22: 8052. (TSS)

42648 (BNWL-805) OXIDATION OF CERIUM(III) BY OZONE AND BY ELECTROLYSIS. Lerch, R. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 1968. Contract AT(45-1)-1830. 24p. Dep. CFSTI.

Cerium(III) can be electrolytically oxidized to cerium(IV) on a batch type basis in glass, titanium, or zircaloy vessels, but not in a stainless steel vessel. The process would probably consist of concentrating the cerium to between 0.1M and 0.15M in 2M to 8M nitric acid followed by oxidation and then extraction using 0.3M HDEHP (bis(2-ethylhexyl) ester of phosphoric acid)–0.2M TBP (tributyl phosphate) in NPH diluent. The use of ozone is not feasible for oxidation of cerium(III) to cerium(IV) since the rate of reaction is very slow (even with a catalyst) and because a holding oxidant is necessary during the extraction step. (auth)

42649 (CEA-R-3398) KINETIC STUDY OF THE REACTION OF NITROGEN WITH URANIUM MONOCARBIDE. Herrmann, Franz-Josef (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Apr. 1968. 49p. (In French). Dep.

The nitridation of uranium monocarbide pieces, microspheres, and powder, was investigated in the temperature range from 700 to 1200°C and the kinetics of this reaction specified, using a thermogravimetric experimental procedure. In every case; the kinetics appears to be linear, except for massive monocarbide at temperatures above 950°C, which obeys following the rate law: $\Delta m^x = Kt$, with $x = 1.5 \pm 0.1$. Accordingly, the activation energy varies from 15 to 30 kcal/mole. Furthermore, as evidenced by the curves $K = F(P)$, the rate of nitridation increased proportionally to the square root of nitrogen pressure. The particular behavior of the powders can be accounted for through a study of their temperature. On the basis of all experimental results, a reaction mechanism is suggested. (auth)

42650 (COO-1109-35) THE SOLID STATE CHEMISTRY OF RARE EARTH OXIDE SYSTEMS. Technical Progress Report, 1967-1968. Eyring, Leroy; Jenkins, Michael S.; Scherer, Volker; Stone, G. Duane; Turcotte, Rheal P.; Warmkessel, Joyce M.; Weber, Gary R. (Arizona State Univ., Tempe. Dept. of Chemistry). July 10, 1968. Contract AT(11-1)-1109. 98p. Dep. CFSTI.

Research progress is reported on: detailed tensimetric studies of the praseodymium oxide–oxygen system, mass transport properties of rare earth oxides, high-temperature x-ray diffraction studies, and growth of rare earth oxide crystals. (M.C.G.)

42651 (IA-1162) DIFFERENTIATION BETWEEN Ho I AND Ho II SPECTRA USING ONLY A DC ARC AS EXCITATION SOURCE. Held, S. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). May 1968. 65p. Dep.

Differentiation between the neutral and ion spectra of Ho in the 2260 to 5454 Å spectral range was achieved using only a dc arc as excitation source. The spectrum assignments are supported by differences in the line intensities of the Ho spectra obtained in electrodeless discharge and spark excitation. The wavelengths were taken from Gatterer and Junkes. (auth)

42652 (NLCO-1020) SUMMARY TECHNICAL REPORT [ON FEED MATERIALS PRODUCTION], APRIL 1, 1968–JUNE 30, 1968. (National Lead Co. of Ohio, Cincinnati). Aug. 1968. Contract AT(30-1)-1156. 16p. Dep. CFSTI.

The heat of formation of Mg_2C_3 was determined to be −75.0 kcal/mole at 1300°K. The formation of an electrically conducting material by the reactions of uranium metal with halide salts in a graphite crucible was investigated. A helium–neon continuous-wave gas laser was used as an illuminating source for an optical microscope. Resolution and contrast were improved. (M.C.G.)

42653 (NP-17448) ANNUAL REPORT, 1966-67. (Commonwealth Scientific and Industrial Research Organization, Clayton (Australia). Div. of Chemical Physics). 1967. 48p. Dep.

Research progress is reported under the following topics: general, spectroscopy, mass spectroscopy, electron diffraction, electron microscopy, x-ray diffraction, solid-state chemistry, theoretical chemistry, instruments and engineering services, and service and collaborative work. (M.C.G.)

42654 (NYO-2082-18) HIGH TEMPERATURE INORGANIC CHEMISTRY. Tenth Annual Progress Report. Grosse, A. V.;

Krieg, Gary M. (Temple Univ., Philadelphia, Pa. Research Inst.). July 15, 1968. Contract AT(30-1)-2082. 30p. (RITU-1968-14). Dep. CFSTI.

Developments in the following studies are reported: surface tension of the alkali metals from their melting points to the critical region; thermal diffusivity and Prandtl number of liquid Hg and K from melting point to critical point; empirical correlation of the activation energies for high-temperature creep, stress-rupture, and self-diffusion of solid metals with those for viscosity and self-diffusion of liquid metals; equation of state for Cs electric conductivity of liquid La; reaction of liquid Fe and Co with solid thoria at 2000 to 2500°K; reaction between liquid alkaline earth metals (Ca, Sr, and Ba) with the refractory metals (Mo, W, Nb, and Ta); and weightless double lenses of two liquid metals (Ga and Na–K alloy). (J.G.B.)

42655 (PG-Report-837) PREPARATION AND PROPERTIES OF THERMOLUMINESCENT LITHIUM BORATE. Brunskill, R. T. (United Kingdom Atomic Energy Authority, Sellafield (England). Production Group). 1968. 23p. Dep. CFSTI. UK 4s. 0d.

A consistently sensitive thermoluminescent lithium borate has been made by melting a molecular proportioned mixture of boric acid and lithium carbonate in an argon atmosphere. The material is twice as sensitive as the commercially available product. Lithium borate requires no heat treatment after read-out and before re-use and its dose response to γ radiation in the energy range 17 to 100 keV is within 10% of tissue equivalent. By simple modifications to the reading unit, the total background arising from the heating of undosed powder, is only 3 to 4 Mrad. In neutron free areas there are clear technical advantages in the use of lithium borate for the measurement of $\beta\gamma$ and γ doses. (P.C.H.)

42656 (UCRL-13352) THE CHEMICAL BEHAVIOR OF IODINE IN DILUTE SOLUTION. Report No. 3, March 22–June 22, 1968. Boyd, Howard A. Jr.; Kahn, Milton (New Mexico Univ., Albuquerque. Dept. of Chemistry). Contract W-7405-eng-48. 24p. Dep. CFSTI.

Significant amounts of ^{131}I activity were extracted from perchloric acid solutions (above 1$\underline{F}$), which initially contained active iodide at concentrations below 10^{-5} $\underline{F}$. At iodide concentrations below 10^{-7} $\underline{F}$ in perchloric acid solutions greater than 1$\underline{F}$, large amounts of activity were apparently adsorbed by the walls of reaction vessels. The amount of activity adsorbed varied with age of the active solution, concentration of the acid, and concentration of the total initial iodide. It was established that the loss of activity to the walls of Pyrex reaction vessels containing strong acid solutions of carrier-free iodide-131 may be traced to the presence of contaminants or impurities in the concentrated perchloric acid stock used to prepare active reaction mixtures. The loss of activity to the walls of polyethylene vessels seems to be due to additional factors. Using carrier-free iodide-131 solutions of strong perchloric acid where adsorption of activity by the walls of Pyrex reaction vessels was low, solvent extraction analyses revealed that most of the activity in these solutions could be extracted with benzene. The extractable activity behaved primarily as one species; most of the results indicated the extractable species was similar to molecular iodine. It is noteworthy that considerably less activity was extracted when these active acid solutions were diluted prior to extraction; sulfuric acid solutions showed a similar effect but not nitric acid solutions. Essentially, quantitative removal of the ^{131}I activity from these strong perchloric acid solutions was effected by coprecipitation with silver chloride in a slight excess of either silver or chloride ion. (auth)

42657 THERMOCHEMICAL STUDY OF URANIUM OXYCARBIDE. Namba, Shingo; Imoto, Shosuke (Osaka Univ.). Technol. Rep. Osaka Univ., 18: 91-104(Mar. 1968).

The heat of formation and the heat capacity of $UC_{1-x}O_x$, uranium oxycarbide, were measured for the values of x from zero to 0.84, from which the standard heat of formation of $UC_{1-x}O_x$ was calculated. The heat formation at the reaction temperature of 640°K was determined by measuring the heat of combustion of $UC_{1-x}O_x$ using the differential thermal analysis method, whose result is $\Delta H^0_{640} = -21.3 - 108.5x$ Kcal/mole. Measurements of heat capacity were done over a temperature range from room temperature to about 640°K. The result is: $Cp = 13.95 + 0.32 \times 10^{-3}T - 191 \times 10^5T^{-2}$ cal/mole · deg. The standard heat of formation of $UC_{1-x}O_x$, estimated from the heat of formation at 640°K and the heat capacity from 298.16° to 640°K, is $\Delta H^0_{298.16} = -21.7 - 108.5x$ Kcal/mole. Thermochemical discussion on the stability of $UC_{1-x}O_x$ was also carried out. (NSA of Japan)

42658 THE ENTHALPIES, ENTROPIES, AND GIBBS ENERGIES OF FORMATION OF THE RARE EARTH OXIDES. Holley, Charles E. Jr.; Huber, Elmer J. Jr.; Baker, Floyd B. Progr. Sci. Technol. Rare Earths, 3: 343-433(1968).

The enthalpies of formation of most of the rare earth oxides were measured. Many measurements were also made of the heat capacities of the metals and oxides at both low and high temperatures. A critical assessment of these data was made with the purpose of calculating the values of the thermodynamic functions at various temperatures, with some indication of the uncertainties involved. Scandium and yttrium are included. (auth) (UK)

42659 MONOCARBIDES AND MONONITRIDES OF THE RARE EARTHS. Lallement, R. (CEN, Fontenay-aux-Roses, France); Veyssie, J. J. Progr. Sci. Technol. Rare Earths, 3: 284-342(1968). (In French).

A review is given under the following main headings: methods of preparation; experimental results (electrical resistivity, superconductivity of LaN, valency changes in CeN, role of impurities, effects of crystalline field, magnetoresistance, thermoelectric power, thermal conductivity, specific heat, magnetic transitions, magnetic specific heats, other magnetic properties, study in the ordered region, magnetic resonance, study of magnetic properties by neutron diffraction); and interpretation of results. (UK)

42660 STUDY ON THE BEHAVIOR OF SULFUR BETWEEN H_2S AND ZnS BY AN ISOTOPIC EXCHANGE METHOD. Sakaguchi, Masakazu; Hirabayashi, Takakuni (Niigata Univ., Nagaoka, Japan). Nippon Kagaku Zasshi, 89: 248-52(Mar. 1968). (In Japanese).

In order to understand the role of firing atmosphere in the preparation of ZnS phosphor, the behavior of sulfur on the solid–gas interface during the firing in $H_2{}^{35}S$ atmosphere was investigated by an isotopic exchange technique. The precipitated ZnS(0.5 g.) was fired at 300 to 1150°C under 1 atm of H_2S by a static method, then specific activities of gas phase(H_2S), solid phase(ZnS) and sulfur deposited on the cold junction of reaction vessel were measured, and the amount of sulfur migrated among these materials was analyzed by an isotopic dilution method. The exchange reaction of sulfur on the solid–gas interface proceeded readily and the sulfur transferred to the solid phase was uniformly distributed into the bulk above 500°C and the amount exchanged showed a maximum above 500°C. The sulfur deposited was mainly from the solid phase rather than from the gas phase. The analysis of thermal decomposition of ZnS by a differential thermal balance indicated that sulfur was evaporated preferentially below 500°C, followed by the evaporation of zinc at higher temperatures, and finally the sublimation of ZnS above 1050°C. From these results, the role of firing atmosphere is described by the formation of lattice defect due to the sintering of ZnS particle and to the phase transition of the crystal. (auth)

42661 INITIATION STEP OF METHANE PYROLYSIS. Yano, Takayuki; Kuratani, Kenji (Tokyo Univ.). Bull. Chem. Soc. Jap., 41: 799-802(Apr. 1968).

Equimolar mixtures of CH_4 and CD_4 were pyrolyzed at 1560°K by a reflected shock wave. From the isotope distribution of H_2, HD, and D_2 which are components of the product in early stage, the initiation step of methane pyrolysis is concluded to be the splitting to a methyl radical and a hydrogen atom. (auth)

42662 SOIL POTASSIUM AVAILABILITY AND RESERVE AS RELATED TO THE ISOTOPIC POOL AND CALCIUM EXCHANGE EQUILIBRIA. Graham, E. R.; Kampbell, D. H. (Univ. of Missouri, Columbia). Contract AT(11-1)-1014. Soil Sci., 106: 101-6(Aug. 1968). (TID-23969).

A study of 22 Missouri soils in relation to the labile pool obtained with ^{42}K exchange plus the extractable ^{39}K obtained with calcium exchange, the total potassium obtained by chemical analysis, and a study of available potassium with soybeans revealed the following information of interest. (a) The size of the labile pool obtained varied with the soil sample and was related to inherent fertility. A large labile pool revealed high available potassium to soybeans and correlated with the mean concentration of the first trifoliate with a coefficient of correlation of 0.91. The soils showing large amounts of labile pool potassium correlated well with potassium reserves as shown by chemical analysis of total potassium, by inherent fertility as recognized from observed field testing and agreed with the multiple extract concept as suggested by Hagin and Feidenbaum. (b) The potassium pool obtained by isotopic exchange was almost identical with the potassium exchanged by eight extracts of the soil with 0.01 $\underline{M}$ $CaCl_2$. (c) It is possible that studies of the labile potassium pool of soils by isotopic exchange and Ca exchange equilibria will furnish information of value for predicting both available and reserve potassium in soil. (auth)

42663 ENRICHED UF_6: PURCHASE PRICE FROM THE USAEC. Jelinek-Fink, P.; Skorpil, B. (Nuklear-Chemie und

-Metallurgie GmbH, Hanau, Ger.). Atomwirt., Atomtech., 13: 362-6(July 1968). (In German).

The USAEC has sold enriched uranium hexafluoride (UF_6) since 1956 at list prices, which are from time to time revised. The list prices valid from 1/1/68 are discussed in light of the individual price components. From 1/1/69 on it will be possible to have enriched uranium hexafluoride produced by the USAEC through toll enrichment. From that time the toll enrichment procedure will be the standard process for supplying nuclear power stations with enriched material. There are in practice three ways of obtaining enriched UF_6 from the USAEC: purchase according to the price list, leasing, and the toll enrichment procedure. Enriched material can only be leased up to a maximum value of $125,000 and as a further limitation it was established that such material can only be obtained in this way for research and experimental reactors. Even if the costs of uranium concentrate rise so high that purchase according to the USAEC list price would be economically more favorable it would still be impossible to supply nuclear power stations solely with material acquired in this way. The possibilities for purchase by this method are limited. The toll enrichment contracts envisage that the reactor operator can supply his own reprocessed uranium as feed material for enrichment. (auth)

42664 RADIATION INDUCED AROMATIC HYDROGEN ISOTOPE EXCHANGE IN AQUEOUS SOLUTION. Adsetts, J. R.; Gold, V. (King's Coll., London). Chem. Commun., No. 15, 915-16(1968).

A study is described of tritium exchange between mesitylene and aqueous HCl at 25°C. It was found that in addition to an acid catalyzed exchange there was a contribution to the initial rate which was essentially independent of acid concentration and was proportional to the square of the tritium concentration over the range 0 to 32 Ci/l. Similar behavior was found with benzene. The square-dependence is strong indication of a process induced by tritium β-decay. The main radioactive reaction product was identified as mesitylene; no radioactive polynuclear aromatic species and no isomeric trimethylbenzenes were formed in detectable amount. Oxidation to trimesic acid and tritium assay of the purified acid indicated that 93 ± 6% of the total mesitylene activity was in the ring positions. The extent of radiation damage was generally only ~10% of the total mesitylene. The exchange was probably not directly caused by the β-particle or a recoil species, and the absence of organic by-products argues against participation of electronically excited aromatic species. Observations appeared consistent with a reaction between the mesitylene and T-atoms, formed as primary products of interaction of the β-particle with the tritiated solvent. It was found that the exchange process could be inhibited by cupric ions, which are effective competitors for H. and T.; it was also shown that T-atoms, and not solvated electrons, initiated the exchange. The results demonstrated that radiolysis of organic compounds in tritium-containing aqueous solution allows fundamental organic reactions to be clearly identified, but also point to practical limitations of the use of tritium in exchange and tracer studies. (UK)

42665 ISOTOPIC EFFECTS ON VAPOR PRESSURE. III. DEUTERATION EFFECT ON THE VAPOR PRESSURE OF ALCOHOLS. Kiss, I.; Jakli, Gy.; Jancso, G.; Illy, H. (Central Research Inst. for Physics, Budapest). Acta Chim. Acad. Sci. Hung., 56: 271-84(1968).

The differences between the vapor pressures of propanol-1, propanol-2, butanol-1, butanol-2, 2-methyl-propanol-2, pentanol-3 and their derivatives deuterated at the hydroxyl group were determined over a wide range of temperatures. Using the experimental data and the virial equation for alcohol vapors, the distillation separation factor α was evaluated for each pair of isotopic compounds and fitted by the method of least squares to Bigeleisen's equation, $\ln \alpha = A/T^2 - B/T$. Considering both the present and earlier data, it seems that the value of constant B, determined by the zero-point energy shift of the internal vibrations on condensation, depends either on the order of the alcohol or on the molecular symmetry. (auth)

42666 KINETIC STUDIES OF FERROUS ION OXIDATION WITH CRYSTALLINE HUMAN FERROXIDASE. III. EFFECTS OF DEUTERIUM AND TEMPERATURE ON THE ENZYMIC OXIDATION OF FERROUS ION. Osaki, Shigemasa; Walaas, Otto (Univ. of Oslo). Arch. Biochem. Biophys., 125: 918-23(June 1968).

The effects of D_2O in the reaction mixture and temperature change on the oxidation of Fe(II) by crystalline human ferroxidase (ferrous-O_2-oxidoreductase, EC 1.12.3) were studied. It was found that the enzymic activity of ferroxidase was inhibited 42 to 43% in 66% deuterium containing buffer, which was observed by Fe (III)-transferrin formation or by a stopped-flow method. It was concluded that a part of the D_2O effect on the enzyme activity may be due to the exchange of hydrogen closely related either geometrically or electronically to the active center of the enzyme. The following thermodynamic parameters of Fe(II) oxidation by ferroxidase were obtained: $\Delta H^* = 10.3$ kcal/mole, $\Delta F^* = 17$ kcal/mole, and $\Delta S^* = -22.9$ cal/mole/degree, for the reaction in 100% H_2O medium with nondeuterated enzyme; and $\Delta H^* = 9.9$ kcal/mole, $\Delta F^* = 17.3$ kcal/mole, and $\Delta S^* = -25.3$ cal/mole/degree, for the reaction in 66% D_2O + 34% H_2O medium with deuterated enzyme, respectively. The relatively large entropy change, and its more negative value in the deuterated reaction mixture, suggest that geometrical or electronical rearrangements, or both, of hydrogen atoms closely related to active sites of the enzyme molecule may be involved in the rate-determining step of the ferroxidase activity. (auth)

42667 ROLE OF IMPURITIES AND D_2O SUBSTITUTION ON FLUORESCENCE LIFETIMES OF URANYL SALTS. Pant, D. D.; Pant, H. C. (D.S.B. Government Coll., Naini Tal, India). Indian J. Pure Appl. Phys., 6: 219-22(May 1968).

Lifetimes (τ) of various uranyl salts were measured at room temperature and 80°K. The anomalies in certain data, for example in uranyl sodium acetate and uranyl chloride, are explained to be due to the presence of other uranyl impurity. The fresh samples are found to have longer τ and variation in τ of different uranyl salts arises due to the difference in the oscillator strength of the first electronic transition in absorption. Effect of D_2O substitution on τ of uranyl sulfate ($UO_2SO_43H_2O$) and potassium uranyl sulfate ($K_2UO_2SO_42H_2O$) was studied. While the sulfate shows an increase in τ on deuteration, no such effect was observed in potassium uranyl sulfate. The behavior is discussed on the basis of the ideas developed by G. W. Robinson and R. P. Frosch [J. Chem. Phys., 38 (1963), 1187]. An increase in τ on D_2O substitution results from a smaller value of Franck–Condon overlap integral between the excited state and the ground state vibrational levels in resonance with the former, leading to a non-radiative dissipation process. In uranyl potassium sulfate where the quantum yield is unity at low temperatures, such processes are absent. The observed fact that no D_2O effect is found in such a salt appears to support the theory of Robinson and Frosch. (auth)

42668 ABSORPTION SPECTRUM OF AMMONIUM URANYL SULPHATE. Narasimham, K. V.; Girija, M. (Metcalfe House, Delhi). Indian J. Pure Appl. Phys., 6: 231-5(May 1968).

The electronic absorption as well as the ir absorption spectra of ammonium uranyl sulfate, $(NH_4)_2UO_2(SO_4)_2 \cdot 2H_2O$, were reinvestigated. For the electronic absorption bands, an analysis was proposed on the basis of four electronic transitions from the common ground state to the different upper states. In the analysis, besides the uranyl frequencies, frequencies of the sulfate ion and crystal lattice were obtained. In the ir spectrum, an interpretation for some of the bands was proposed on the basis of the frequencies of the uranyl ion, sulfate ion, ammonia ion, and water of hydration. (auth)

42669 INVESTIGATION OF EQUILIBRIUM BETWEEN METALLIC PLUTONIUM AND ITS IONS IN MOLTEN CHLORIDE SALTS. Silin, V. I.; Skiba, O. V.; Smirnov, M. V.; Yakovlev, G. N.; Prikhod'ko, E. A. At. Energ. (USSR), 25: 26-9(July 1968). (In Russian).

A dependence of equilibrium plutonium potentials in molten salts, $PuCl_3-NaCl$ and $PuCl_3-NaCl-KCl$ over the temperature range 710 to 870°C and a concentration of plutonium of 0.6 to 11.9 wt% was investigated. The following equations of temperature and concentration dependence of plutonium potential according to the Cl_2 reference electrode were obtained; for $NaCl-PuCl_3$, $E_1 = -3.605 + 9.83 \times 10^{-4}T + 0.661 \times 10^{-4}T \lg[Pu^{3+}]v$ and for $NaCl-KCl-PuCl_3$, $E_2 = -3.577 + 9.25 \times 10^{-4}T + 0.661 \times 10^{-4}T \lg[Pu^{3+}]v$. The thermodynamic values of $PuCl_3$ formation and its interaction with salt-solvent are, respectively, for NaCl: $\Delta H_1^\circ = -249.4$ kcal/mole, $\Delta S_1^\circ = -68.0$ cal/mole deg, $\Delta H_{interact}^\circ = -38.4$ kcal/mole, $\Delta S_{interact}^\circ = -34.1$ cal/mole deg; for NaCl–KCl: $\Delta H_2^\circ = -247.5$ kcal/mole deg, $\Delta S_2^\circ = -64.1$ cal/mole deg, $\Delta H_{interact}^\circ = -36.5$ kcal/mole, $\Delta S_{interact}^\circ = -30.2$ cal/mole deg. (auth)

42670 EFFECT OF SURFACE BOILING ON DEPOSITION VELOCITIES OF GAS OIL DECOMPOSITION PRODUCTS. Bogdanov, F. F.; Utkin, O. I. At. Energ. (USSR), 25: 15-21(July 1968). (In Russian).

Results of experimental studies of the influence of surface boiling and some other factors on accumulation intensity of heating gas oil-cooled surfaces are presented. The tests with fresh gas oil show that in the presence of intensive surface boiling the decompositions are not accumulated at the heating wall temperature of t = 320°C, but in the absence of the surface boiling this surface remains clean at $T_w = 350$°C and even at $T_w = 360$°C. The heat flux may be increased only to values at which temperature drop at the pre wall layer does not lead to surface boiling. It was found that the heating wall temperature of 380 to 390°C results in intensive accumulation of depositions even in the absence of surface boiling. At a heating wall temperature of 340°C and in the presence of surface boiling deposits are accumulated even in the absence of polymer impurities in the coolant. Experiments made with polymer-free gas oil from the reactor primary circuit show that the operation properties of this gas oil do not differ from those of fresh gas oil. The permissible temperature of the heating wall in the absence of the surface boiling is $\approx$350°C irrespective of the presence of polymers. (auth)

42671 PHYSICAL AND CHEMICAL PROPERTIES OF HEAVY METAL FLUORIDE MIXTURES. PART I. LIQUID–VAPOR PHASE EQUILIBRIUM OF URANIUM HEXAFLUORIDE–TUNGSTEN HEXAFLUORIDE SYSTEM. Prusakov, V. N.; Ezhov, V. K. At. Energ. (USSR), 25: 35-8(July 1968). (In Russian).

The liquid–vapor phase equilibrium of UF_6–WF_6 mixture was studied at pressures: 1520, 1900, 2290, and 2660 mm Hg. The system shows negative deviation from ideal behavior. The formation of an azeotrope is not observed. (auth)

42672 CONDENSED PHASE ISOTOPE EFFECTS. Van Hook, W. Alexander (Univ. of Tennessee, Knoxville). Isotopenpraxis, 4: 161-9(May 1968).

The vapor pressure isotope effect is discussed in the light of the available theory for both associated and nonassociated condensed phases. The effects are sensitive to the details of the molecular structure and to the details of the intermolecular force field which characterizes the condensed phase. As such, they form good probes for certain aspects of the study of the liquid state. In the cases where a complete analysis was possible, satisfactory agreement was demonstrated between theory and experiment. (auth)

42673 ISOTOPIC EXCHANGE OF HYDROGEN BETWEEN THE FLUIDS OF THE HYDROCARBON FIELDS. Blaga, L. (Inst. for Atomic Physics, Cluj). Isotopenpraxis, 4: 178-83 (May 1968).

The isotopic exchange of hydrogen in natural gas, crude oil, and underground water is discussed. The general behavior of the isotopic exchange occurring in a system with a large number of components is given. Good agreement between the calculated and the experimental isotopic distribution factors was obtained in the case of the isotopic exchange of hydrogen between methane and underground water. The deuterium concentration of the crude oil samples inserts between the values obtained for methane and underground water. This fact is due to the presence of the isotopic exchange between these fluids. (auth)

42674 STUDIES ON THE CATALYTIC RECOMBINER FOR BOILING-WATER REACTOR. I. ANALYSIS OF THE CATALYTIC REACTION RATE EQUATION. Murata, Toshifumi; Yusa, Hideo (Hitachi, Ltd., Tokyo). Nippon Genshiryoku Gakkaishi, 10: 377-83(1968). (In Japanese).

An investigation of the catalytic recombination of hydrogen and oxygen was carried out to obtain reaction rate data for the preliminary design and feasibility studies of recombiners to be used in the off-gas system of a boiling-water reactor. A catalytic reaction rate equation on the basis of the idea of a nondimensional diffusion control factor η defined as the ratio of mass transfer coefficient of a gas film to apparent reaction rate constant was studied. The reaction rate equation was confirmed experimentally under the condition of constant temperature over the catalyst bed, and constants of the alumina-supported palladium catalysts were determined. (auth)

42675 FORMATION AND REACTIVITY OF OXIDES AND BASIC SALTS. II. RADIOISOTOPE STUDIES OF SOME CALCAREOUS MATERIALS. Glasson, D. R.; Huff, E. G.; Jones, J. A.; Sheppard, Margaret A. (Coll. of Tech., Plymouth, Eng.). J. Appl. Chem. (London), 18: 204-8(July 1968).

Rates of calcium exchange between solid and solution in the ageing of hydrated lime and of calcium carbonate samples were determined using ^{45}Ca. After a comparatively rapid calcium uptake of about 1 molecular layer at the hydrated lime surface, the exchange rate diminished as the ions needed to diffuse more deeply into the hydrated lime structure. Results for calcium carbonate samples of widely different specific surfaces are compatible with very slow ageing in water. Rates of gypsum precipitation from radioactive calcium chloride and nitrate solutions were compared in neutral and acidic media and in the presence of albumen. Lower gypsum saturation ratios were established ultimately in neutral rather than acidic media, particularly in solutions containing no salts other than gypsum. Solid hydrated lime reacted rapidly with dilute sulfuric acid, aluminum, and magnesium sulfates, magnesium chloride, or seawater, releasing calcium ions into solution. The radioactivities of the solutions decreased subsequently as gypsum separated out or calcium ions were adsorbed by the finely-divided magnesium hydroxide precipitated. At higher magnesium salt concentrations the ^{45}Ca radioactivity did not initially increase so sharply. This is ascribed to basic salt formation preventing all of the lime from passing quickly into solution. (auth) (UK)

42676 INFRARED SPECTRA OF CRYSTALLINE $CHCl_3$ AND $CDCl_3$. Kimoto, Arata; Yamada, Haruka (Kwansei Gakuin Univ., Nishinomiya, Japan). Bull. Chem. Soc. Jap., 41: 1096-1104(May 1968).

The infrared spectra for the fundamental absorption bands, ν_1, ν_2, ν_4, and ν_5, of $CHCl_3$ and $CDCl_3$ were measured in polycrystalline films. For the C–H or C–D bending band a triplet was observed in the pure crystal. The spectra of a mixed crystal ($CHCl_3$:$CDCl_3$) were also studied over the entire concentration range. The space group of crystalline chloroform was determined to be D_{2h}^{16}. The intensity of the band changes, going from the gas to the solid, depending on the symmetry species to which the vibrational mode belongs; the A_1 bands increase in intensity, while the E bands decrease. The C–H stretching band shows an especially remarkable increase. (auth)

42677 KINETICS OF ISOTOPIC EXCHANGE BETWEEN 8-QUINOLINOL-^{14}C AND TRIS-8-QUINOLINOLATO COMPLEXES OF TERVALENT TYPICAL ELEMENTS. Saito, Kazuo; Takahashi, Michihiko; Miyakawa, Yukio; Masuda, Kazuyo (Tohoku Univ., Sendai). Bull. Chem. Soc. Jap., 41: 1139-42(May 1968).

Rate of isotopic exchange between 8-quinolinol-^{14}C and the 8-quinolinolato (oxinato) complexes of aluminum, gallium, and indium was studied in chloroform. Pure yellow complexes are precipitated by adding petroleum ether to the reaction mixture. The exchange rate decreased in the sequence In > Al > Ga, and a detailed kinetic study can be substantiated only with the gallium complex below 0°C. The rate is proportional to the concentration of the complex, but is independent of that of free 8-quinolinol (quinolH) and the Arrhenius activation energy is 18 kcal per mole. The reaction is accelerated by acid and presumably by water. It appears as if one of the ligands is present as unidentate under the given condition and the break of the remaining bond would be the rate determining step. Any reagent that can retard the recombination of the free end of unidentate ligand would catalyze the exchange reaction. (auth)

42678 OXYGEN EXCHANGE AND RACEMIZATION REACTIONS OF SULFOXIDES IN ACETIC AND CHLOROACETIC ACID. Oae, Shigeru; Yokoyama, Mikihiko; Kise, Masahiro (Osaka City Univ.). Bull. Chem. Soc. Jap., 41: 1221-4(May 1968).

Oxygen exchange reaction of sulfoxides was performed mainly in mineral acids such as sulfuric acid, aqueous hydrochloric, and hydrobromic acids. It was found that concurrent oxygen exchange and racemization reactions take place also in carboxylic acids such as acetic, mono- and poly-chloroacetic acids. The pseudo first order reaction rates of both oxygen exchange and racemization reactions of p-tolyl phenyl sulfoxide were determined using both optically active and ^{18}O-labeled p-tolyl phenyl sulfoxides in these acids. This reaction is found to be mainly dependent on the strengths of the acids; namely, the reaction velocity is faster in an acid of smaller pK_a value. Together with the fact that k(rac.)/k(exch.) is unity and the substituent effect is small, the reaction is suggested to proceed through an unimolecular type S–O bond cleavage, probably involving radical cation intermediate (II). (auth)

42679 BEHAVIOR OF HYDROGEN CHEMISORBED OVER THE ELECTRON DONOR–ACCEPTOR COMPLEXES OF AROMATIC HYDROCARBONS WITH SODIUM IN THE HYDROGEN EXCHANGE AND HYDROGENATION REACTIONS. Tanaka, Sadao; Ichikawa, Masaru; Naito, Shuichi; Soma, Mitsuyuki; Onishi, Takaharu; Tamaru, Kenzi (Tokyo Univ.). Bull. Chem. Soc. Jap., 41: 1278(May 1968).

When deuterium gas was introduced onto the 1 : 1 and 1 : 2 anthracene–sodium complex films in the temperature range 25 to 90°C, a considerable amount of HD was formed reversibly; the apparent activation energies for the reactions were approximately 16 and 12 kcal/mole respectively. The film of the anthracene–sodium (1 : 2) complex was approximately ten times as active as that of the 1 : 1 complex for the hydrogen exchange. After the exchangeable hydrogens in these complexes were replaced with deuterium to a considerable extent by treating the complexes with deuterium gas at 80°C, the deuterated positions in these complexes were studied by means of the ESR and NMR techniques. By admitting the hydrogen gas onto the thin films of 1 : 1 and 1 : 2 anthracene–Na complexes, a new peak appeared at 432 mμ, while the peaks due to the dinegative anion and to the mononegative radical anthracene in the complexes decreased correspondingly. (D.H.M.)

42680 SPECTROPHOTOMETRIC STUDIES OF COLOUR REACTIONS OF UO_2^{2+}, Th^{4+}, AND MoO_4^{2-} WITH KAEMPFEROL AND ROBINETIN. Garg, B. S.; Trikha, K. C.; Katyal, M.; Singh, R. P. (Univ. of Delhi). Indian J. Chem., 6: 334-6(June 1968).

The complexes formed when UO_2^{2+}, Th^{4+}, and MoO_4^{2-} ions react with kaempferol and robinetin were spectrophotometrically studied. All these metal ions form 1 : 1 complexes with the ligands; in the case of UO_2^{2+}–robinetin and MoO_4^{2-}–robinetin systems 2 : 1 complexes are also formed. The stability constants, molar extinction coefficient, etc., for the complexes were also calculated. (auth)

42681 THORIUM(IV) COMPLEXES OF 8-HYDROXYQUINOLINE AND DERIVATIVES. Corsini, A.; Abraham, J. (McMaster Univ., Hamilton, Ont.). Chem. Commun., No. 15, 856-7(1968).

There has been considerable speculation concerning the binding of the additional molecule of 8-hydroxyquinoline in $Th(C_9H_6NO)_4 \cdot C_9H_6N\ OH$. It is thought that this molecule is either coordinated to the metal ion or is an uncoordinated crystal lattice component. Evidence is reported that the molecule is coordinated to the thorium ion through the phenolate oxygen and that the acidic proton in the complex is located on the nitrogen atom of the monodentate ligand. On treatment of the complex with a dichloroethane solution containing excess of 8-hydroxy (^{14}C) quinoline little activity could be detected in it, a result contrary to that expected for a lattice compound and suggesting that the adduct is a molecular entity. The ir spectrum was also investigated and showed bands characteristic of hydrogen bonded $>NH^+$. The coordination number of Th in the complex is nine. The ir spectra of the pentakis complexes formed between Th(IV) and 5-acetyl-, 5-nitro-, 5-phenyl-, 7-methyl-, and 7-phenyl-8-hydroxyquinoline also showed bands characteristic of hydrogen bonded $>NH^+$. The solution species of $Th(C_9H_6NO)_4 \cdot C_9H_6N\ OH$ in dichloroethane were also investigated, including formation of ten coordinate species. Species formed in dimethyl sulphoxide were also studied. (UK)

42682 THE FORCE CONSTANTS OF THE COMPOUNDS $^{12}CF_4$, $^{13}CF_4$, $^{28}SiF_4$, $^{29}SiF_4$, $^{30}SiF_4$, GeF_4 AND SO_3. Ruoff, A. (Laboratorium fuer anorganische Chemie, Stuttgart). Spectrochim. Acta, Part A, 23: 2421-31(Aug. 1967). (In German).

Coriolis coupling constants were calculated from band contours for the above molecules according to the most recent literature values. With the help of a modified gradient method these ζ-values serve to establish the force fields. For some isotopic substitutions the force field is altered, and these changes, as well as the approximated absolute error, are discussed. (auth) (UK)

42683 OBSERVATION OF A MINIMUM IN THE KERR CONSTANTS OF LIGHT AND HEAVY WATER NEAR 30^0. Chen, Yeong-jgi; Orttung, William H. (Univ. of California, Riverside). J. Phys. Chem., 72: 3069-70(Aug. 1968).

Data on the temperature dependence of the Kerr constants of H_2O and D_2O from 5 to 55°C at 365 mμ (and at 436 mμ for D_2O) are reported. The data were fitted by the least squares method and the values of the Kerr constant were plotted against temperature. The results could not be interpreted by existing theories. (D.H.M.)

42684 TEMPERATURE OF MAXIMUM DENSITY OF HEAVY WATER SOLUTIONS. Darnell, A. J.; Greyson, J. (North American Rockwell Corp., Canoga Park, Calif.). J. Phys. Chem., 72: 3032-4(Aug. 1968).

Values of the temperature of maximum density (T_M) of heavy and normal water solutions of alkali chlorides (LiCl, NaCl, KCl, RbCl, CsCl) are reported for various concentrations. In all cases the value of T_M was reduced by the presence of the salts indicating structure-breaking influence. The T_M was also reduced by each of the salts proportionally to its concentration. The relative order of suppression of T_M by the salts was the same in D_2O as it was in H_2O. With the exception of LiCl, however, each of the salts at any given concentration lowers T_M of H_2O to a somewhat greater extent than T_M of D_2O. Possible explanations for these results are considered. (D.H.M.)

42685 DEHYDRATION OF ALCOHOLS OVER ALUMINA. VIII. THE ETHER FORMATION FROM THE DEUTERATED METHANOLS CH_3OH, CD_3OH, CH_3OD, AND CD_3OD. Knoezinger, H.; Scheglila, A.; Watson, A. M. (Univ., Munich). J. Phys. Chem., 72: 2770-4(Aug. 1968).

The ether formation from CH_3OH, CD_3OH, CH_3OD, and CD_3OD was investigated in a quasi-static circulation apparatus. Within the range of error, it can be shown that the activation energies for the ether formation do not give rise to primary isotope effects. The most probable mechanism for the ether formation is suggested to be the reaction of a surface alkoxide group with a molecular adsorbed alcohol molecule. The alkyl group of the alkoxide, acting as an electrophile agent, attacks the hydroxyl oxygen of the alcohol molecule. The rate-determining step is presumably the rupture of the R–OAl bond of the alkoxide. (auth)

42686 NONEXPONENTIAL PHOSPHORESCENCE DECAY OF BENZENE. Martin, T. E.; Kalantar, A. H. (Univ. of Alberta, Edmonton). J. Chem. Phys., 49: 244-52(July 1, 1968).

The nonexponential decay of the $^3B_{1u}$ state of benzene was studied in different phases of cyclohexane and methylcyclohexane at 77°K. C_6H_6, C_6H_5D, sym-$C_6H_3D_3$, C_6HD_5, and C_6D_6 are the benzenes examined. In cyclohexane, the multiplet structure of the benzene spectrum depends on the substitutional sites (cubic or monoclinic) in which benzene lies. Observed nonexponential decay arises from a combination of two first-order lifetimes. These are associated with the individual multiplets. The shorter lifetime arises from benzenes in cubic sites. In methylcyclohexane, where no multiplets are observed, spectral shifts and lifetime changes, together with triplet-buildup kinetic measurements, indicate a similar origin for the observed nonexponential decay. The decay curves, reproducible to within 1%, are quantitatively analyzed using a two-site model. Effects of the environment on the lifetime of benzene are discussed in terms of possible changes in the Franck–Condon factors for radiationless decay. (auth)

42687 CH AND CD STRETCHING ANHARMONICITIES AND RADIATIONLESS DECAY OF TRIPLET BENZENE. Martin, T. E.; Kalantar, A. H. (Univ. of Alberta, Edmonton). J. Chem. Phys., 49: 235-43(July 1, 1968).

The near-ir spectra of liquid chloroform and benzene were analyzed to evaluate the CH and CD diagonal and cross anharmonicity constants. For $HCCl_3$ and $DCCl_3$, the diagonal anharmonicities (–124 and –66 cm^{-1}, respectively) and the rate of intensity decrease of successive overtones showed an isotope effect. The more complex C_6H_6, C_6H_5D, C_6HD_5, and C_6D_6 spectra yielded both diagonal and cross terms, which are –116 and –150 for C_6H_6 and –63 and –87 cm^{-1} for C_6D_6, respectively, and show the same isotope effects. The analysis indicated that the only CH stretching progression arises from a combination overtone $\nu_{20}(e_{1u}) + n\nu_2(a_{1g})$, and is due to the considerable anharmonicity associated with an asymmetric potential function. The pattern of anharmonicity in C_6D_6 is greatly changed by replacing one D by an H. The relationship of the CH stretching anharmonicity to the radiationless rate constants derived from phosphorescence lifetimes is discussed. (auth)

42688 ELECTRICAL PROPERTIES OF THORIUM BORIDES. Auskern, A. B.; Aronson, S. (Brookhaven National Lab., Upton, N. Y.). J. Chem. Phys., 49: 172-6(July 1, 1968). (BNL–12145).

The electrical resistivity, Hall coefficient, thermoelectric power, and magnetic susceptibility of polycrystalline samples of thorium tetraboride and thorium hexaboride were measured over a range of temperatures. Both compounds exhibit metallic properties. The carrier concentration, about 2 electrons per thorium atom, is that predicted by the bonding model of Lipscomb and Britten. (auth)

42689 DISSOCIATION BEHAVIOR OF URANIUM MONOCARBIDE. Vozzella, P. A.; Miller, A. D.; DeCrescente, M. A. (United Aircraft Corp., Middletown, Conn.). J. Chem. Phys., 49: 876-81(July 15, 1968).

Uranium monocarbide was found to lose uranium preferentially in the temperature range from 2250 to 2525°K until a constant vaporizing, nonstoichiometric composition approaching $UC_{1.1}$ was formed. Rates of evaporation of this composition, measured from 2190 to 2525°K by the Langmuir method, are described by $\log_{10}m(UC_{1.1(s)}) = 9.148 - 3.574 \times 10^4T^{-1}$ ($g\ cm^{-2} \cdot sec^{-1}$). Based on the decomposition process, $UC_{1.1(s)} \rightarrow U_{(g)} + n_1C_{1(g)} + n_2C_{2(g)} + n_3C_{3(g)}$, the partial pressure of uranium is given by $\log_{10}PU_{(g)}(atm) = 8.191 - 3.624 \times 10^4T^{-1}$. The partial pressure of carbon, expressed as effective monatomic pressure, is $\log_{10}P_c = 8.341 - 3.608 \times 10^4T^{-1}$. These data yield a heat of vaporization at 298°K of 235.1 × 2.7 kcal/mole for the above vaporization process. The resultant standard heat of formation of $UC_{1.1(s)}$ at 298°K is -21.2 ± 4.1 kcal/mole if 125 ± 3 kcal/mole is taken as the heat of sublimation of uranium. (auth)

42690 CRYSTALLOGRAPHIC DATA ON SOME HYDRATED COMPLEXES OF URANIUM(IV) FLUORIDE WITH NICKEL, COBALT, OR COPPER. Charpin, Pierrette; Montoloy, Francois; Nierlich, Martine (CEA, Gif-sur-Yvette, France). Compt. Rend., Ser. C, 266: 1685-7(June 17, 1968). (In French).

Studies on monocrystals showed that complex fluorides with the formula $2UF_4 \cdot MF_2 \cdot 8H_2O$, where M is nickel or cobalt, are monoclinic and that the corresponding complex of copper is orthorhombic. (tr-auth)

42691 INFLUENCE OF METHYL GROUP ON THE RATE OF HYDROGEN ISOTOPE EXCHANGE IN o-, m, AND p-POSITIONS OF TOLUENE-CHROMOTRICARBONYL IN ALKALI MEDIA. Kursanov, D. N.; Setkina, V. N.; Baranetskaya, N. K.; Anisimov, K. N. (Inst. of Organic Compounds, Moscow). Izv. Akad. Nauk SSSR, Ser. Khim., No. 7, 1622-3(July 1968). (In Russian).

Hydrogen isotopic exchange between tricarbonyl(toluene) chromium and ethanol in the presence of sodium ethoxide was studied and the factors of partial rate for the O-, M-, and P-, positions in the aromatic ring of the system were determined. (tr-auth)

42692 VISCOSITY OF ORDINARY WATER AND HEAVY WATER AT HIGH PRESSURES FROM 0 TO 150°C. **Agaev, N. A.; Yusibova, A. D. (Azerbaidzhan Scientific Research Inst., Baku). Dokl. Akad. Nauk SSSR, 180: 334-7(May 11, 1968). (In Russian).**

Studies were made of the viscosity of normal and heavy water at 0 to 150°C and 1 to 1200 kg/cm^2. The tabulated data and diagrams show that at the freezing point the H_2O and D_2O viscosity isotherms have an abnormal character: with increased pressure the water viscosity decreased passing through a minimum after which it rose again; with the increasing temperature these minima decreased, shifting into the side of lower pressures. Experimental data on H_2O and D_2O viscosity were compared to the published literature and the results were in agreement within 0.1 to 0.4%. (R.V.J.)

42693 LUMINESCENT URANIUM GLASS. **Chang, Hsing-yuan; Ch'u, T'ien-ming; Chiang, Pai-min; Ku, Ken-sheng. Keui Suan Yen Hsueh Pao, 4: 255-8(1965). (In Chinese).**

Methods are described for preparation of U glass. Its composition and luminescent properties are discussed. The influence of the content of UO_2 in glass on its emission of light is demonstrated. Glass was manufactured that contained 0.3 to 4.0% UO_2. The maximal emission of light was attained at 1.0 to 2.0% content of UO_2, with maximal radiation at ~ 530 mμ. The influence of other components of uranium glass on its luminescence spectrum and emission of light was also established. 10 references are cited. (JPRS)

42694 REACTIONS IN SOLID PHASE. I. **Singh, Kartar (DSL, Delhi). Def. Sci. J. (New Delhi)., 16: 1-26(1966).**

In a study of chemical reactions, the following topics are reviewed: application of activated complex theory to decomposition in the solid phase; band theory and imperfections in solids; photographic sensitivity and radiolysis; chemical reactivity in solids; and catalysis. (68 references) (Indian Sci. Abstr.)

42695 PRIMARY KINETIC ISOTOPE EFFECT IN THE FRIEDEL–CRAFTS ACYLATION REACTION. **Vanhaverbeke, Dirk (Katholieke Univ., Louvain, Belg.). Meded. Vlaam. Chem. Ver., 29: 110-15(July-Aug. 1967). (In Flemish).**

The ratio k_H/k_D in the $AlCl_3$-catalyzed benzoylation of aromatic compounds was studied. It is independent of solvent or the initial concentration of $C_6H_5COCl-AlCl_3$ in CH_2Cl_2, but is strongly influenced by a substituent in the benzoyl chloride or the aromatic hydrocarbon. Thus the ratio for toluene vs pentadeuterotoluene at 35°C in C_6H_5Cl, $\underline{o}$-$C_6H_4Cl_2$, 1,2,4-$C_6H_3Cl_3$, and CH_2Cl_2 was 2.03, 2.04, 1.90, and 2.00 respectively. An increase from 0.2 to 0.4 in the initial molar concentration of the complex in CH_2Cl_2 raised the ratio from 2.00 to 2.01; the same change in chlorobenzene produced an increase from 2.17 to 2.46. The substituents $\underline{m}$-Cl, $\underline{p}$-CH_3, and $\underline{p}$-CH_3O give ratios of 2.54, 1.70, and 2.07 in $\underline{o}$-$C_6H_4Cl_2$; the hydrocarbons, benzene and $\underline{m}$-xylene, compared with their ring-deuterated analogs, give values of 1.50 and 2.67. A mechanism is proposed to explain these results in which both monomers and dimers of the $C_6H_5COCl-AlCl_3$ complex and associated aromatic hydrocarbons are involved at the transition state in a complex mechanism. (BBB)

42696 RECENT RESULTS IN GAS-CHROMATOGRAPHIC DEUTERATION OF ORGANIC COMPOUNDS. **Jancso, G.; Kiss, I. (Zentralforschungsinstitut fuer Physik, Budapest). Isotopenpraxis, 4: 220-2(June 1968). (In German).**

Compounds with mobile hydrogen atoms can be deuterated by isotopic exchange on a preparative gas chromatograph. For compounds with less mobile hydrogen the deuteration can be carried out in the presence of an alkaline catalyst. The relative exchange rates were determined for various compounds and were found to be comparable to the ionization rates. The activation energy for gas chromatographic isotope exchange could be established for some compounds. The dependence of the deuterium exchange on the flow rate of the carrier gas, the temperature, the length of the column, and the catalyst concentration was investigated. (auth)

42697 BATTERIES OF SOLID ELECTROLYTE FUEL CELLS WITH URANIUM OXIDE ANODE LAYERS. **Rohland, B.; Moebius, H.-H. (Univ., Greifswald, Ger.). Naturwissenschaften, 55: 227-8(May 1968). (In German).**

Films of uranium oxide with and without the addition of zirconium and yttrium oxides were sintered to solid electrolytes at 1600°C. Cells of the type, fuel gas, $Ni/U(Zr,Y)O_x/Zr_{0.84}Y_{0.10}Mg_{0.06}O_{1.89}/Ag$, air, were prepared. The construction of the battery is illustrated. The current-voltage characteristics were determined for operation with hydrogen at 838 ± 5°C. (J.S.R.)

42698 NEW 1967 ATOMIC WEIGHTS OF ELEMENTS. **Zatka, Vladimir (Inst. of Chemistry and Tech., Prague). Chem. Listy, 62: 579-83(May 1968). (In Czech).**

The 1967 international (IUPAC, Prague Conf.) atomic weights based on $^{12}C = 12$ are given for the 103 elements of the periodic table together with atomic weights, half-lives, and types of decay for 22 radioactive nuclides. The recently discovered element 104 (kurchatovium) is not included. Changes introduced in 1967 include new data on values for atmospheric neon and for natural magnesium and chromium. Errors in spectrometric measurements were corrected by comparison with pure samples of materials. Discrepancies in chromium atomic weights were eliminated. Further revisions will be made in 1969. (TTT)

42699 INFLUENCE OF DEUTERONS ON PROTON RELAXATION TIMES IN PARAMAGNETIC SOLUTIONS. **Padmavathi, G. (Andhra Univ., Waltair, India). Indian J. Pure Appl. Phys., 6: 216-18(May 1968).**

The influence of deuterons on proton relaxation times was studied by measurements on proton relaxation times in aqueous solutions of paramagnetic ions when D_2O replaces H_2O in varying amounts and in $(H_2O + D_2O)$ mixtures of varying relative concentrations. The paramagnetic ions studied are Mn^{2+} with ^6S ground state and Ni^{2+} and Ce^{3+} with F ground states. It is observed that there is always an increase in proton relaxation time when D_2O replaces H_2O; in all the three cases this increase is larger as the percentage of D_2O is increased; and the relative increase is very much larger in the case of Ce^{3+} and Ni^{2+} ion solutions than in the case of Mn^{2+} ion solution. This large increase in relaxation where D_2O concentration is increased is accounted for, as due to the proton exchange across hydrogen bond. The larger relative increase in the case of Ce^{3+} and Ni^{2+} ions than that in Mn^{2+} ion may arise from the difference in the ground states of these ions. (auth)

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Refer also to abstracts 42664, 44277, and 44541.

42700 (AD-664883) PULSE RADIOLYSIS OF POLYSTYRENE. **Ho, S. K.; Siegel, Seymour; Schwarz, Harold A. (Aerospace Corp., El Segundo, Calif.). Oct. 1967. Contract F04695-67-C-0158. 31p. (TR-0158(3250-20)-1; SAMSO-TR-68-30). CFSTI.**

The optical absorption spectra of the transient species produced by pulse electron radiolysis of polystyrene are reported. Polystyrene samples containing various aromatic solutes, as well as solute-free polystyrene samples, were examined. In solute-free polystyrene, the negative ion of polystyrene was observed. However, in samples containing triphenylamine as a solute, the solute positive ion was observed. The decay constants of the ion populations are of the order of milliseconds. In polystyrene samples containing aromatic solutes, the only new species observed were the corresponding solute triplet state molecules. Analysis of the data indicated that the energy transfer from host polymer to solute occurs by a random walk migration of singlet state excitation energy in the polymer. Solute triplet state molecules were formed by intramolecular intersystem crossing in the solute molecule. (USGRDR)

42701 (AD-664757) SOME ASPECTS OF THE RADIATION CHEMISTRY OF THE TRICHLOROETHYLENE–OXYGEN–WATER SYSTEM. **Sasse, Ronald (Army Nuclear Defense Lab., Edgewood Arsenal, Md.). Jan. 1968. 26p. (NDL-TR-99). CFSTI.**

The radiation chemistry of the trichloroethylene (TCE) system was investigated. G-(H(+)) and G-(Cl(–)) were determined as e(–)aq or OH was scavenged with either hydrogen ion, ethanol, or phenol. These G-values are given as functions of scavenger concentration. From this study it was found that H + TCE produces little if any Cl(–). It was also found that G-(H(+)) and G-(Cl(–)) cannot be constants beyond 10 krad in oxygen-free solution whereas they are constants to higher doses in the presence of oxygen. (auth) (USGRDR)

42702 (AEC-tr-6937) ANNUAL REPORT OF THE JAPANESE ASSOCIATION FOR RADIATION RESEARCH ON POLYMERS. Volume 8, 1966–1967. **Translation of Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 8: 1-193(1966-1967). 201p. Dep. CFSTI.**

Research progress is reported in 21 sections. Separate abstracts were prepared from the original language for 20 of these sections and appeared as NSA: 8117 through 8135 and 22: 8052. One section (p. 176–83 of the translation; p. 169–76 of the original) is abstracted below. (M.C.G.)

For abstracts of individual sections see: 42647, 42703–42721, and 43853.

42703 (AEC-tr-6937, pp 21-32) PROPERTIES OF STYRENE GRAFTED CELLULOSE. Kimura, Fujiko; Okada, Toshio; Sakurada, Ichiro. Translated from Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 8: 19-30(1966-67).

An abstract of this paper, prepared from the original language, appeared as NSA 22: 8119. (TSS)

42704 (AEC-tr-6937, pp 12-20) OXYGEN UPTAKE DURING IRRADIATION AND POST-IRRADIATION GRAFT COPOLYMERIZATION OF STYRENE ONTO POLYVINYL ALCOHOL. Kimura, Fujiko; Sakurada, Ichiro. Translated from Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 8: 11-18(1966-67).

An abstract of this paper, prepared from the original language, appeared as NSA 22: 8118. (TSS)

42705 (AEC-tr-6937, pp 33-44) RADIOLYSIS OF POLY (VINYL ALCOHOL). I. GASEOUS PRODUCTS FROM POLY (VINYL ALCOHOL) AND DEUTERATED POLY (VINYL ALCOHOL) WITH GAMMA IRRADIATION. Okada, Toshio. Translated from Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 8: 31-41(1966-67).

An abstract of this paper, prepared from the original language, appeared as NSA 22: 8120. (TSS)

42706 (AEC-tr-6937, pp 45-53) EFFECT OF BENZALIZATION AND BENZOYLATION ON IRRADIATION DAMAGE OF POLYVINYL ALCOHOL FILMS. Kohdera, Kanako; Kimura, Fujiko; Sakurada, Ichiro. Translated from Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 8: 43-50(1966-67).

An abstract of this paper, prepared from the original language, appeared as NSA 22: 8121. (TSS)

42707 (AEC-tr-6937, pp 54-8) RADIATION INDUCED POLYMERIZATION OF SOME CYCLIC MONOMERS IN LIQUID STATE. Ueno, Katsuji (Kyoto Univ.); Tsukamoto, Hiroshi; Hayashi, Koichiro; Okamura, Seizo. Translated from Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 8: 51-4(1966-67).

An abstract of this paper, prepared from the original language, appeared as NSA 22: 8122. (TSS)

42708 (AEC-tr-6937, pp 59-68) FREE ION MECHANISM ON RADIATION INDUCED POLYMERIZATION OF ISOBUTYL VINYL ETHER. Ueno, Katsuji (Kyoto Univ.); Hayashi, Koichiro; Okamura, Seizo. Translated from Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 8: 55-64(1966-67).

An abstract of this paper, prepared from the original language, appeared as NSA 22: 8123. (TSS)

42709 (AEC-tr-6937, pp 69-74) STUDIES ON RADIATION INDUCED IONIC POLYMERIZATION. PART 6. EFFECT OF HIGH ELECTRIC FIELD ON POLYMERIZATION OF STYRENE. Uneo, Katsuji (Kyoto Univ.); Hayashi, Koichiro; Okamura, Seizo. Translated from Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 8: 65-70(1966-67).

An abstract of this paper, prepared from the original language, appeared as NSA 22: 8124. (TSS)

42710 (AEC-tr-6937, pp 75-83) STUDIES ON RADIATION INDUCED IONIC POLYMERIZATION OF STYRENE. PART 7. EFFECT OF ELECTRON SCAVENGERS ON POLYMERIZATION OF STYRENE. Ueno, Katsuji (Kyoto Univ.); Hayashi, Koichiro; Okamura, Seizo. Translated from Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 8: 71-8(1966-67).

An abstract of this paper, prepared from the original language, appeared as NSA 22: 8125. (TSS)

42711 (AEC-tr-6937, pp 84-95) STUDY ON THE RADIATION INDUCED FREE ION YIELDS IN N-ALKANES. Takada, Kiyoshi; Takagaki, Torao; Hayashi, Kanae; Hayashi, Koichiro; Okamura, Seizo. Translated from Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 8: 79-88(1966-67).

An abstract of this paper, prepared from the original language, appeared as NSA 22: 8126. (TSS)

42712 (AEC-tr-6937, pp 96-103) ESTIMATION OF FREE ION LIFETIME BY PULSE ELECTRICAL CONDUCTIVITY. Hayashi, Kanae; Takagaki, Torao; Takada, Kiyoshi; Hayashi, Koichiro; Okamura, Seizo. Translated from Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 8: 89-95(1966-67).

An abstract of this paper, prepared from the original language, appeared as NSA 22: 8127. (TSS)

42713 (AEC-tr-6937, pp 109-16) ESR STUDY ON THE IRRADIATED ORGANIC GLASS CONTAINING STYRENE. Tsuji, Kozo (Kyoto Univ.); Yoshida, Hiroshi; Hayashi, Koichiro; Okamura, Seizo. Translated from Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 8: 103-9(1966-67).

An abstract of this paper, prepared from the original language, appeared as NSA 22: 8128. (TSS)

42714 (AEC-tr-6937, pp 117-32) ELECTRON SPIN RESONANCE STUDY OF IRRADIATED CYCLIC ETHERS. Tsuji, Kozo (Kyoto Univ.); Yoshida, Hiroshi; Hayashi, Koichiro; Okamura, Seizo. Translated from Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 8: 111-25(1966-67).

An abstract of this paper, prepared from the original language, appeared as NSA 22: 8129. (TSS)

42715 (AEC-tr-6937, pp 133-44) ESR STUDY OF IRRADIATED POLYOXYMETHYLENE. Tsuji, Kozo (Kyoto Univ.); Okaya, Takuji; Hayashi, Koichiro; Okamura, Seizo. Translated from Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 8: 127-37 (1966-67).

An abstract of this paper, prepared from the original language, appeared as NSA 22: 8130. (TSS)

42716 (AEC-tr-6937, pp 145-57) SPECTROSCOPIC STUDIES ON RADIATION INDUCED POLYMERIZATION. 2. RADIATION INDUCED POLYMERIZATION OF ISOBUTENE AT LOW TEMPERATURE GLASSY STATE. Kamiyama, Hideo; Hayashi, Koichiro; Okamura, Seizo. Translated from Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 8: 139-50(1966-67).

An abstract of this paper, prepared from the original language, appeared as NSA 22: 8131. (TSS)

42717 (AEC-tr-6937, pp 158-69) STUDIES ON RADIATION INDUCED SOLID STATE POLYMERIZATION ON THE CHAIN PROPAGATION IN THE SOLID STATE. Nishii, Masanobu; Hayashi, Koichiro; Okamura, Seizo. Translated from Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 8: 151-61(1966-67).

An abstract of this paper, prepared from the original language, appeared as NSA 22: 8132. (TSS)

42718 (AEC-tr-6937, pp 170-5) RADIOLYSIS OF METHYL N-BUTYL ETHER. Takezaki, Junichi; Hirota, Kozo. Translated from Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 8: 163-8(1966-67).

An abstract of this paper, prepared from the original language, appeared as NSA 22: 8133. (TSS)

42719 (AEC-tr-6937, pp 176-83) QUANTITATIVE EXPLANATION OF THE SKELETAL BOND-SCISSION OF CYCLIC ETHERS BY ELECTRON IMPACT. Takezaki, Jun'ichi; Hirota, Kozo. Translated from Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 8: 169-76(1966-67).

Bond-scission probabilities of cyclic ethers under electron impact are explained quantitatively by the LCBO-MO theory. It can be calculated by the assumptions that cycle opening occurs at each bond in proportion to the charge density of cyclic ether and the parent ions subsequently produced are of ether and aldehyde type, and these ions decompose into smaller fragment ions decomposing in proportion to the charge density of each parent ion, and that $C=O$ bond in aldehyde type ions does not rupture, irrespective of its charge density. The theoretical values show a good correlation to the scission probability of the corresponding bond obtained from the mass spectra. (auth)

42720 (AEC-tr-6937, pp 184-91) ESR STUDY OF IRRADIATED POLYETHERS. Sugimoto, Shun-ichi; Ohnishi, Shun-ichi; Nitta, Isamu. Translated from Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 8: 177-83(1966-67).

An abstract of this paper, prepared from the original language, appeared as NSA 22: 8134. (TSS)

42721 (AEC-tr-6937, pp 192-201) ELECTRON SPIN RESONANCE STUDIES OF IRRADIATED BORON COMPOUNDS. II. SINGLE CRYSTAL OF BORAX. Nagai, Siro; Ohnishi, Shun-ichi; Nitta, Isamu. Translated from Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 8: 185-93(1966-67).

An abstract of this paper, prepared from the original language, appeared as NSA 22: 8135. (TSS)

42722 (BNL-50110) RADIATION AND ORGANIC LIQUIDS. Brookhaven Lecture Series Number 70. Metz, Donald J. (Brookhaven National Lab., Upton, N. Y.). Nov. 15, 1967. 12p. Dep. CFSTI.

Organic radiation chemistry is considered under the following topics: organic compounds, the liquid state, formulation of the problem, end-product analysis, identification of intermediates, free radicals, ions, and ion-radicals. (M.C.G.)

42723 (COO-1618-7) COMPUTER SIMULATION OF HOT-ZONE REACTIONS. Anselmo, Vincent C.; King, Theodore; Rekart, Theodore (New Mexico Highlands Univ., Las Vegas. Dept. of Chemistry). Aug. 2, 1968. Contract AT(11-1)-1618. 7p. Dep. CFSTI.

A computer-simulated model is being developed that will provide not only a rationalization for the final chemical products from recoil reactions, but should also be useful in explaining isothermal annealing and solvent effects. The chemical system studied was neutron-irradiated ammonium hypophosphite. This model represents an attempt at simulation of reactions in the hot zone. (M.C.G.)

42724 (COO-1618-8) RADIATIVE-NEUTRON-CAPTURE REACTIONS IN ORTHOPHOSPHATES: THE CATION EFFECT. Anselmo, Vincent C.; Rekart, Theodore (New Mexico Highlands Univ., Las Vegas. Dept. of Chemistry). Aug. 2, 1968. Contract AT(11-1)-1618. 4p. Dep. CFSTI.

Data were collected on several different oxidation states formed in radiative neutron capture reactions in orthophosphates. For mono-alkali metal orthophosphates, there was a reduction as hypophosphite and orthophosphite, with an increase in the fraction as orthophosphate as the atomic weight of the cation increased. For di-alkali metal orthophosphates there appeared to be no dependence on cation. There was also a large increase in the fraction as orthophosphite. (M.C.G.)

42725 (EURAEC-2024) RADIATION DAMAGE ON CHLORINE FLUORIDES USED FOR REPROCESSING OF FAST BREEDER FUEL. Parthey, H. (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium)). [1967]. Contracts 006-65-7-RCIB(RD); 016-65-1-RAP-B. 29p. (EUR-3799). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

Data on potential radiation damage to chlorine fluorides, utilized for fluoride volatility reprocessing of fast nuclear fuel are reviewed. The formation of fluorine by thermal decomposition of chlorine trifluoride predominates over the generation of fluorine by radiation damage on chlorine fluorides. (auth)

42726 (NSJ-tr-108) EFFECT OF ADDITIVES ON THE RADIATION-INDUCED POLYMERIZATION OF TRIOXANE. Naruse, Tsutomu; Haga, Mikio; Fueki, Kenji; Kuri, Zen-ichiro. Translated from Kogyo Kagaku Zasshi, 69: 527-30(Mar. 1966). 12p. Dep.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 17680.

42727 (RFP-Trans-31) OXIDATION OF CARBON MONOXIDE ON NICKEL OXIDE AND ZINC OXIDE: THE EFFECT OF PRELIMINARY ^{60}Co GAMMA RAY IRRADIATION. Peers, Arthur Mackenzie; Dran, Jean-Claude; Ohno, Shinichi. Translated from J. Chim. Phys., 62: 711-17(1965). 15p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 19: 40577.

42728 (RFP-Trans-32) RADIOLYSIS OF ADSORBED CO$_2$. Coekelbergs, Roger; Crucq, Andre; Frennet, Alfred; Decot, Jean; Timmerman, Lucien Translated from J. Chim. Phys., 60: 891-8 (1963). 19p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 17: 34010.

42729 (RFP-Trans-33) ADSORPTION UNDER IRRADIATION. I. ADSORPTION OF OXYGEN AND CARBON MONOXIDE ON ALUMINA. Coekelbergs, R.; Crucq, A.; Decot, J.; Degols, L.; Randoux, M.; Timmerman, L. Translated from J. Phys. Chem. Solids, 26: 1983-93(1965). 20p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 20: 8998.

42730 (RFP-Trans-34) ADSORPTION OF CO AND O$_2$ ON ZnO AND NiO: EFFECTS OF RADIO-COBALT GAMMA RAY IRRADIATION. Peers, A. M.; Dran, J-C. Translated from J. Chim. Phys., 62: 718-27(1965). 27p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 19: 40578.

42731 (RFP-Trans-36) EFFECT OF IONIZING RADIATION ON AQUEOUS SOLUTIONS OF POTASSIUM NITRATE. Kabakchi, A. M.; Gramolin, V. A.; Yerokhin, V. M. Translated from Zh. Fiz. Khim., 32: 2149-54(1958). 12p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 13: 2826.

42732 IRRADIATION FINISHING APPLICATIONS. Stannett, V. (Research Triangle Inst., Research Triangle Park, N. C.). Amer. Dyestuff Rep., 56: 813-17(Oct. 9, 1967).

The work done on using high-energy radiation for modification of textile fibers in recent years is reviewed, and 17 references are cited. The effects of radiation on two types of fibers, those polymers that degrade and those that crosslink, are reported. The largest volume of publications in the field in recent years have dealt with radioinduced graft copolymerization of many different vinyl monomers with polymer fibers. (B.L.M.)

42733 INCREASE IN THE RESISTANCE TO CRACKING OF A HIGH DENSITY POLYETHYLENE CAUSED BY A TREATMENT WITH IONIZING RADIATION. Nalivayko, E. I.; Sirota, A. G. Plast. Massy, No. 9, 14-15(1967). (In Russian).

The resistance of polyethylene to cracking depends on molecular weight, index of melting, degree of crystallinity, and molecular weight distribution. One method of increasing the resistance of low molecular weight polyethylene consists of irradiation, which leads to development of special structure of the polymer. Since no quantitative data are available on this relationship, the radiation doses leading to sharp increases in resistance to cracking were measured. Plates 3 mm thick made of polyethylene of high density with an index of melting in the range from 0.15 to 4 g/10 min were studied. The samples were irradiated with accelerated electrons at an energy of 2.0 to 2.2 MeV at room temperature in a stream of an inert gas. The radiation doses were from 10 to 60 MRAD and dose intensity was 0.4 MRAD/min. To avoid any post effects, the samples were heated after irradiation at 100°C for 30 min in an inert medium. A relationship between the index of melting and the irradiation dose was discovered necessary for a considerable increase in the period of resistance to cracking, so, with index of melting <1.5 g/10 min, a 10 MRAD dose was sufficient, while with an index of melting of 4 g/10 min, a 20 MRAD dose was necessary. With an increase of resistance to cracking a considerable increase in the yield point and the maximum tolerance to stretching was observed. (ATD)

42734 MECHANISM OF ELECTRIC CONDUCTIVITY INDUCED BY IRRADIATION IN ORGANIC DIELECTRICS WITH A HIGH CONCENTRATION OF TRAPS. Frankevich, E. L. (Inst. of Chemical Physics, Moscow). Khim. Vys. Energ., 1: 572-5 (1967). (In Russian).

The stabilization of electrons and positive charges in traps is reviewed, taking into account the fact that most electrons are stabilized in the Coulomb field. The current carriers are only those electrons that do not recombine with "their" ions. The radiation yield of such electrons depends on the dose rate and temperature. At high temperatures, radioinduced electrical conductivity is determined only by those electrons that escaped initial recombination; their radiation yield is small. At low temperatures, when the lifetime of the electrons in the traps becomes greater than the recombination of the free current carrier with the stabilized one, practically all electrons resulting from the irradiation become current carriers. With rising radiation intensity or with dropping temperatures, the radiation yield of current carriers approaches the full yield of the charges. At low temperatures the recombination mechanism begins to function and this leads to a rise in the radiation yield of the current carriers. (ATD)

42735 STUDY OF THE TEMPERATURE DEPENDENCE OF THE ELECTRIC CONDUCTIVITY OF POLYMERS IRRADIATED BEFOREHAND AT LOW TEMPERATURES. Sichkar, V. P.; Vaisberg, S. E.; Karpov, V. L. (Inst. of Physical Chemistry, Moscow). Khim. Vys. Energ., 1: 561-6(1967). (In Russian).

Films (25 to 100 μ thick) of high- and low-pressure polyethylene, polypropylene, and polystyrene were irradiated in vacuum not over 10^{-2} to 10^{-1} mm Hg at -130 to -120°C using 0.6 to 0.7 MRAD on a γ-cobalt unit. Electric conductivity was measured 30 min after irradiation, starting at -110 to -120°C, with gradual heating of the specimens at a rate of 0.6 to 0.7 deg/min. Determination error did not exceed ±10%. Results are compared with those in the literature. Comparison showed that the release of electrons from capture centers (traps), which determines the γ-stimulated electrical conductivity, is closely related to molecular movement in polymer chains of polyethylene. This conclusion was applied to polypropylene and polystyrene. The capture centers can be certain sections of the chain, e.g., $-CH_3$ groups or other polar groups. It is highly improbable that these groups include >C = 0 joined to the main of the macromolecule but it is possible that >C = 0 groups joined to side chains of the macromolecule play a substantial role. (ATD)

42736 RADIATION COPOLYMERIZATION OF TETRAFLUOROETHYLENE AND HEXAFLUOROPROPYLENE. Sun, Chia-chen; Kao, Kuo-ching. Kao Fen Tzu T'ung Hsun, 5: 123-30 (Nov. 1963). (In Chinese).

The radiation copolymerization of tetrafluoroethylene and hexafluoropropylene was investigated at -78°C with a 20,000-Ci ^{60}Co γ source. Values of the copolymerization rate constant decreased with the increase in the amount of hexafluoropropylene in the monomer mixtures. This indicates that hexafluoropropylene has a lower copolymerization reactivity. Values of n in the rate equation $R = KI^n$ are 0.60, 0.78, and 0.85, as the mole fractions of hexafluoropropylene in the monomer mixtures are 0.1, 0.5, and 0.7, respectively. This signifies that an increase in hexafluoropropylene concentration lowers the probability of biradical termination. A post-effect of the copolymerization was noticed. Values of k_p/k_t in post-polymerization increased with irradiation dosage due to the decrease in k_t resulting from the enrichment of trapped polymeric radicals as a consequence of increased "in source" conversion on higher irradiation doses. The effect of some common organic solvents and inhibitors on the copolymerization rate was also studied. Most of the results support a free-radical mechanism for this low-temperature liquid-phase radiation copolymerization; possibilities of simultaneous radical-cationic polymerization or of cationic polymerization, however, can not be ruled out. (JPRS)

42737 EFFECT OF SUBSTITUENTS ON THE RADIATION STABILITY OF AROMATIC COMPOUNDS. Trofimov, V. I.; Chkheidze, I. I.; Buben, N. Ya. (Inst. of Chemical Physics, Moscow). Khim. Vys. Energ., 1: 509(1967). (In Russian).

It was shown previously that aromatic and heteroaromatic compounds are very stable to radiation. For most of the compounds studied, the radiation yields of stabilized free radicals G(R) at low temperature range from 0.03 to 0.5 1/100 eV, and the yields of gaseous products, from 5×10^{-4} to 5×10^{-1} 1/100 eV. The introduction of alkyl substituents always leads to a certain decrease of radiation stability, and the introduction of the functional groups NO_2, NH_2, COOH, OH, COCl, Cl, and Br causes an increase in stability. It was observed that the introduction of one or more CH_2 groups between the conjugated ring and the above groups increases the yield of radicals several tens of times. The yields G(R) in these compounds (irradiation with 1.6-MeV electrons at 100 to 130°K) amount to 1 to 3 1/100 eV, while in compounds without CH_2 groups the yields are 0.03 to 0.1 1/100 eV. A further study of the radiolysis mechanism in many systems of this kind is necessary in order to elucidate this phenomenon. (ATD)

42738 THERMOOXIDATION OF IRRADIATED POLYETHYLENE. I. INFLUENCE OF CHEMICAL STRUCTURE. Liu, Jun-shan; Chen, Cheng-lin; Liu, K'o-ching. Chung Kuo K'o Hsueh Yuan Ying Yung Hua Hsueh Yen Chiu So Chi K'an, No. 12, 35-47(Oct. 1964). (In Chinese).

The oxidation kinetics of irradiated and unirradiated polyethylene were noticeably different. The differences were pronounced during the first phase of the process. The rate of oxidation of the former was much faster than the latter and the rate increased with increased radiation dose because the increased dosage induced further structural reorientations. The reason that the initial oxidation of irradiated polyethylene is faster is due to the larger number of double bonds, particularly those due to ethylene double bonds in the trans-position. The relation of the destruction of the double bonds to the accumulation of peroxides and the increase of carboxyl and hydroxyl groups of nonirradiated polyethylene and polyethylene of various dosages indicated that peroxides formed from α-carbon are more stable than those from β and γ. (JPRS)

42739 RADIOINDUCED COPOLYMERIZATION OF VINYL CHLORIDE AND SULFUR DIOXIDE. Suzuki, Hiroshi; Ito, Masayuki (Nagoya Univ., Japan). Kogyo Kagaku Zasshi, 71: 764-7(May 1968). (In Japanese).

Mixtures of vinyl chloride and SO_2 were irradiated with γ rays in a range from room temperature to −196°C. The rate of polymer formation in the liquid state at room temperature and at −78°C was proportional to the feed rate and was inhibited by an addition of 1,1-diphenyl-2-picrylhydrazyl (DPPH). The ratio of vinyl chloride to SO_2 in the copolymer produced depended on temperature. That was 3.6/1 at room temperature and 1/1 at −78°C. The polymer yield depended on the molar concentration of SO_2. The maximum value lay in a lower molar concentration range of SO_2 at room temperature and in a higher molar concentration range at −78°C. The maximum value of the polymer yield occurred around −60°C. In a solid-state polymerization at −196°C, the polymer yield is low. (NSA of Japan)

42740 GAMMA RADIATION EFFECTS ON THE VARIOUS BULK CRYSTALLIZATION STATES OF POLYETHYLENE. Aramaki, Teruo; Takayanagi, Motowo (Kyushu Univ., Japan). Kyushu Daigaku Kogaku Shuho, 40: 850-8(Nov. 1967). (In Japanese).

From a study of the γ irradiation effects on various bulk-crystallization states of polyethylene it was found that bridging by γ irradiation takes place both in the crystallized and the noncrystallized regions. Bridging in the crystallized phase occurs mainly in the partially crystallized part, with the probability being higher than in the noncrystallized phase. The γ effect in the crystallized phase is that high-density bridging is introduced in the molecular chains in the partially crystallized region, a disturbance is caused in the perfect crystal lattice, and simultaneously the lattice is expanded in the α axis, with the result of noncrystallization. The effect in the noncrystallized phase is formation of dense molecular chains by bridging. The factors governing the formation of a bridging are the mobility of molecular chains and the proximity between the chains. (NSA of Japan)

42741 COPOLYMERIZATION OF TRIOXANE WITH ACENAPHTHYLENE. Panayotov, Ivan M.; Dimitrov, Ivan (Inst. of Organic Chemistry, Sofia). Makromol. Chem., 115: 56-63(June 28, 1968).

With the aim of preparing copolymers of trioxane with acenaphthylene, the polymerization of a mixture of both monomers was carried out in the presence of boron trifluoride−diethyl etherate in benzene and tetrachloromethane and in melt. In most monomer ratios, irrespective of the degree of conversion, products were obtained, which were composed of two fractions: one fusible and soluble in benzene and tetrachloromethane, containing almost pure polyacenaphthylene, and another infusible and insoluble in organic solvents with a high polyformaldehyde content. On polymerization of the monomer mixture under the action of γ-rays only insoluble and infusible products were formed. On the basis of the experimental results and the literature data an attempt is made to explain the formation of insoluble products and an opinion is expressed, that no copolymerization of the monomers is likely to take place under the experimental conditions employed. (auth)

42742 SOLID-STATE POLYMERIZATION OF ZINC METHACRYLATE. Parrish, C. F.; Kochanny, G. L. Jr. (Dow Chemical Co., Midland, Mich.). Makromol. Chem., 115: 119-24(June 28, 1968).

Zinc methacrylate was polymerized in the solid state by the post-irradiation technique at 89.5°C. The polymer produced was less isotactic than that obtained from barium methacrylate dihydrate when polymerized under similar conditions. The tacticity of the poly(zinc methacrylate) differed markedly from the polymer produced in the liquid phase from methyl methacrylate or methacrylic acid. X-ray studies of the zinc methacrylate showed the monomer to have an orthorhombic unit cell with lattice constants of a = 17.94 Å, b = 9.16 Å, and c = 13.2 Å. There are 8 molecules per unit cell and the symmetry can be classified as either Pnam or Pna2. The anhydrous monomer shows pronounced thermal polymerization at 89.5°C and the radiation-induced reaction shows no measurable intensity dependency over a 6 fold change in dose rate. (auth)

42743 COPOLYMERS OF VINYL HALIDES WITH OLEFINS. I. QUALITATIVE IR SPECTROSCOPIC INVESTIGATIONS ON VINYL CHLORIDE−PROPENE COPOLYMERS. Pohl, H. U.; Denaxas, J.; Hummel, D. O. (Univ., Cologne). Makromol. Chem., 115: 125-40(June 28, 1968). (In German).

The ir-spectra of two series of vinyl chloride - propene copolymers, polymerized by γ-radiation at −63 and +23°C, were investigated in the range 5000 to 400 cm^{-1}. The correlation of the bands to different structures was based on the change of the band intensities with increasing temperature of polymerization and temperature of the samples during the measurement, as well as on the change of bands with increasing percentage of propene in the samples. The spectra give information on the structure of the polymer chains. (auth)

42744 MOLECULAR WEIGHT DISTRIBUTION OF POLYOXYMETHYLENE OBTAINED IN SOLID-STATE POSTPOLYMERIZATION OF TRIOXANE INDUCED BY γ RAYS. Kobayashi, Eiichi; Okamura, Seizo (Kyoto Univ. Kobunshi Kagaku, 25: 313-17 (May 1968)). (In Japanese).

In order to obtain further information on the solid-state post-polymerization of trioxane induced by γ rays, the fractionation of polyoxymethylene is carried out by stirring the p-chlorophenol solution. The polymer obtained at a low conversion contained a small amount of high-polymer fraction and the amount of high polymer increased with increasing the conversion. This can be explained qualitatively on the assumption that the rate of propagation is smaller than that of the initiation reaction and that the lifetime of the propagating species is rather long. It was found that the molecular weight distribution shows two peaks, of which the distribution in the low molecular weight range is somewhat broad. These results in the molecular weight distribution may be explained because the rates of initiation, propagation, and termination can be expected to fairly differ appreciably in different crystal environment. (NSA of Japan)

42745 RADIATION-INDUCED CHANGES IN COLLAGEN. Mohanaradhakrishnan, V.; Ramanathan, N.; Nayudamma, Y. (Central Leather Research Inst., Madras). Sci. Cult. (Calcutta), 34: 76-80(Feb. 1968).

The effects of γ radiation on the electron microscopy and physical properties of collagen were investigated. The results showed that dry irradiation of kangaroo tail tendon (KTT) and rat tail tendon (RTT) collagen fibers decreased the shrinkage temperature (TS) mean breaking length (MBL), and extension values in all cases. KTT samples irradiated with 30 Mrad dosage swelled and disintegrated even at 0°C when brought into contact with water. The MBL and extension values showed a progressive decrease with dosage. The difference in strength between RTT and KTT was high after irradiation with a dosage of 30 Mrad. Electron micrographs were taken of KTT and RTT fibers after irradiation with γ rays at 10 and 30 Mrad. The irradiated fibrils of RTT (10 Mrad) did not cast long shadows, clearly indicating the flattened appearance of the samples in which the disintegration process appeared to begin. Differences in packing arrangement were visible, and at places, the fibril began to exhibit untwisting of the component units. Other results are also discussed. (P.C.H.)

42746 ELECTRON PARAMAGNETIC RESONANCE STUDIES OF TRANSIENT FREE RADICALS PRODUCED BY PULSE RADIOLYSIS. Smaller, B.; Remko, J. R.; Avery, E. C. (Argonne National Lab., Ill.). J. Chem. Phys., 48: 5174-81(June 1, 1968).

Electron paramagnetic studies were conducted on the transient free radicals produced by pulse radiolysis in liquids. The instrument design permitted observation of radical lifetimes ≥ 2 -3 μsec and corresponding rate constants $\leq 10^{10} M^{-1} \times sec^{-1}$. The effects of radical scavengers such as sulfur-containing compounds or oxygen on the transient behavior of the cyclopentyl and cyclohexyl radical were studied and the pertinent rate constants determined for the reaction. Recombination rate constants for cycloalkyl and well as alkyl- and cycloalkyl-peroxy radicals were compared along with the activation energy for representative species. (auth)

42747 EFFECTS OF HEATING TEMPERATURE AND IRRADIATION ON THE CATALYTIC ACTIVITIES OF ACTIVE CARBONS FOR PHOSGENE SYNTHESIS. Sato, Shoichi; Yoneda, Yukio (Tokyo Univ.). Bull. Chem. Soc. Jap., 41: 824-7(Apr. 1968).

The kinetic factors for phosgene synthesis over thermal irradiated sucrose carbons were examined in particular regard to their dependence on the heating temperature and irradiation. Gamma-irradiation on carbons prepared at 900 or 1000°C produced new active sites with E_A of 11 to 12 kcal/mol. An explanation is suggested of the effects of heating temperature and irradiation on the catalysts; the catalytic activity is most reasonably related to the degree of growth of the network structure of carbons. In the case of carbons prepared by heating at 900 or 1000°C and having the structure grown to the largest extent, a high dose of gamma rays presumedly destroys most efficiently the thermally generated active sites and forms sites with a high activation energy. Free radicals and peripheral atoms which also comprise characteristics of amorphous carbons seem to behave independently of catalytic activities and are supposed to have no direct relation to the activities. (auth)

42748 THE HYDROGEN YIELDS IN THE RADIOLYSIS OF CYSTEINE AND BISCYSTEINATOCOBALTATE(III) IN 0.8 N SULFURIC ACID. Matsuura, Niro; Shinohara, Nobuyoshi (Tokyo Univ.). Bull. Chem. Soc. Jap., 41: 888-92(Apr. 1968).

Radioinduced oxidation of cysteine in an acid medium was studied by measuring the hydrogen yields at an initiation stage of radiolysis. In the deaerated system $G(H_2) = 4.0$ along with the $G(-CySH) = 7.1$ were observed and the results can be interpreted in terms of the yields of primary radicals from the radiolysis of water in 0.8 $\underline{N}$ sulfuric acid medium. From stoichiometric viewpoint it is predicted that the radiolysis takes place through cysteine radical as intermediate to form cystine. In the aerated system on the other hand, the radiolysis of cysteine is very complicated. For a possible explanation satisfying all the G values obtained, 10.5 in the disappearance of cysteine, 4.0 in the formation of hydrogen peroxide and 0.4 in the hydrogen, the air oxidation of cysteine caused by the radicals, HO_2 and OH which produce H_2O_2 and O_2 by the radical recombination, is proposed as mechanism. The radiolysis of cysteine is greatly reduced by complexation with metallic ion as biscysteinatocobaltate(III) complex. The absence of hydrogen abstraction from cysteine by H atom, the isolation of cysteine from a ligand site and the extraordinary high G values in the disappearance of optical absorption of the complex can be cited as characteristics in the radiolysis of the biscysteinatocobaltate(III) complex. The intramolecular redox of the complex into Co(II) ion and cysteine is a best fit mechanism as over all reaction in the radiolysis of the biscysteinatocobaltate(III) complex. (auth)

42749 EFFECT OF AN ELECTRIC FIELD ON THE RADIATION INDUCED FLUORESCENCE FROM SOLUTIONS OF AROMATIC HYDROCARBONS IN CYCLOHEXANE. Morrow, T. (Univ. of Leeds, Eng.); Salmon, G. A.; Frankevich, E. L. Nature (London), 219: 481-2(Aug. 3, 1968).

The radiolysis of dilute solutions of aromatic hydrocarbons results in the production of high yields of electronically excited solute molecules, and charge scavenging experiments indicate that the most probable process for the production of such molecules in cyclohexane solution is charge transfer to the solute, followed by charge neutralization. It would be expected that application of an electric field would influence the product yields from these charge neutralization processes. A study is described of the influence of electric field on the yield of electronically excited singlet state solute molecules by investigating the radiation-induced fluorescence from cyclohexane solutions of anthracene and pyrene. Irradiation was with a DC beam of 3 MeV electrons from a Van de Graaff accelerator. Application of a DC electric field of 10^3 to 1.5×10^4 V/cm resulted in a decrease in fluorescence intensity with both anthracene and pyrene. The percentage change in fluorescence intensity on application of the electric field (1.25×10^4 V/cm) is shown as a function of dose rate for various concentrations of pyrene. At the much higher dose rates ($\sim 10^9$ R/sec) obtained with a pulsed electron beam the fluorescence was unaffected by electric field. Results indicated that the electric field affected fluorescence through influence on secondary processes involving charged species, rather than through any effect on the primary processes of ionization or excitation. The ways in which relatively weak fields may be expected to influence processes involving charged species are discussed. An interesting finding was that excimer and monomer fluorescence behaved differently under electric field influence; this would appear to indicate that excimers are also formed by some other process, such as recombination of anions and cations. (UK)

42750 PRESENCE OF DEOXYCOMPOUNDS IN IRRADIATED CARBOHYDRATES. Scherz, H. (Federal Research Center for Food Preservation, Karlsruhe, Ger.). Nature (London), 219: 611-12(Aug. 10, 1968).

Deoxycompounds were previously found only as radiolysis products of α-methylglucose. Studies are reported that indicate that deoxycompounds are also formed when unsubstituted mono- and disaccharides, starch and cellulose powders are irradiated. Treatment with periodic acid converts deoxycompounds to malondialdehyde, which can be determined by absorptiometric analysis using 2-methylindol. On irradiation of solutions of d-glucose, d-fructose, d-xylose, l-arabinose, d-ribose, and d-sucrose (also solid potato starch and cellulose powder) under nitrogen to 5 MR only fructose gave negative indications for deoxycompounds. More than one such compound may be formed. Cobalt-60 and 10-MeV electrons gave almost identical quantitative results. Assuming that the only deoxycompound formed was 2-deoxyglucose an initial G-value of 0.19 was calculated for glucose, and 0.75 for the sucrose solution. If, for the solid materials, the additional assumption was made that no side reactions occurred which interfered with malondialdehyde formation, initial G-values were 0.05 for potato starch and 0.14 for cellulose powder. Thin layer chromatography of irradiated ribose indicated formation of 2-deoxyribose. Implications for irradiated foodstuffs are briefly discussed (in particular irradiated wheat) (UK)

42751 PROCEEDINGS OF SEMINAR ON WOOD-PLASTIC MATERIALS COMBINATION, SACRAMENTO, CALIFORNIA, JUNE 9, 1967. Sacramento, Calif., Office of Atomic Energy Development and Radiation Protection, 1967. 82p. (CONF-670651).

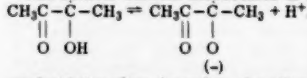
Eight papers and a panel discussion on wood–plastic combinations are presented. Topics covered include: basic research on wood–plastic combinations, experimental work in machine process wood–plastics, role of Southern Interstate Nuclear Board in wood–plastic combination development, WPC made by the catalyst–heat system, economic prospects of the forest products industries, commercialization of irradiated wood–plastic materials, commercial utilization of Novawood, and consumer interest and acceptance. (M.C.G.)

42752 FORMATION OF MALONDIALDEHYDE BY IRRADIATION OF AQUEOUS GLUCOSE SOLUTIONS. Scherz, H.; Stehlik, G. (Reaktorzentrum, Seibersdorf, Austria). Monatsh. Chem., 99: 1143-4(May-June 1968). (In German).

The malondialdehyde content of a 1% aqueous glucose solution irradiated in the presence and absence of oxygen and at various pH values was estimated. From the data obtained a reaction scheme for the formation of malondialdehyde is proposed. (auth)

42753 PULSE-RADIOLYTIC INVESTIGATION OF THE ACETOIN RADICALS AND DIACETYL ANIONS IN AQUEOUS SOLUTIONS. Lilie, J.; Beck, G.; Henglein, A. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Ber. Bunsenges. Phys. Chem., 72: 529-33(July 1968). (In German).

The acetoin radical dissociates in aqueous solution according to



$$CH_3\underset{\underset{O}{\|}}{C}-\underset{\underset{OH}{|}}{\dot{C}}-CH_3 \rightleftharpoons CH_3\underset{\underset{O}{\|}}{C}-\underset{\underset{\underset{(-)}{O}}{|}}{\dot{C}}-CH_3 + H^+$$

. By measuring the electric conductivity after the pulse, the pK value was found to be equal to

4.4. The optical absorption spectra of the acetoin radical and of the diacetyl anion cannot be distinguished. The mean life time of these particles with respect to their mutual deactivation is shortest at pH = pK = 4.4. Absolute rate constants of the reactions of the OH radical and the hydrated electron with acetoin and diacetyl were also determined. Furthermore, the rate constants of the electron transfer from various alcohol radicals to diacetyl were measured. (auth)

42754 VAPOR-PHASE GRAFT COPOLYMERIZATION OF VINYL CHLORIDE AND VINYLIDENE CHLORIDE ON POLYPROPYLENE. SIMULTANEOUS IRRADIATION GRAFTING BY SEALED AMPOULE METHOD. Hayakawa, Kiyoshi; Kawase, Kaoru; Matsuda, Tatsuo (Government Industrial Research Inst., Nagoya, Japan). Radioisotopes (Tokyo), 17: 368-73(Aug. 1968).

The graft copolymerization of gaseous monomers on polypropylene fibers was carried out by a simultaneous irradiation technique. The fibers suspended in the middle of the ampoules were exposed to the vapor of vinyl chloride or vinylidene chloride, and irradiated by γ rays from ^{60}Co. The vapor pressure of monomers was adjusted by changing the temperature of the liquid monomer. In vinylidene chloride grafting the rate of grafting was proportional to the vapor pressure of the monomer and also to the 0.73 th power of the dose rate. The rise in irradiation temperature brought about a marked decrease in the rate, the apparent activation energy of the grafting being −8.0 kcal/mol. In vinyl chloride grafting, the rate of grafting was proportional to the vapor pressure, too, but proportional to the 1.1 th power of the dose rate. The apparent activation energy was almost null. A considerable homopolymer formation and fairly remarkable post-grafting were observed in both vinylidene chloride and vinyl chloride grafting. (auth)

42755 HYDRAZINE CATION RADICAL FORMATION IN γ-IRRADIATED SINGLE CRYSTALS OF HYDRAZINIUM HYDROGEN OXALATE. Edlung, O.; Lund, A.; Nilsson, A. (Swedish Research Councils' Lab., Studsvik). J. Chem. Phys., 49: 749-55 (July 15, 1968).

Room-temperature γ irradiation of hydrazinium hydrogen oxalate single crystals yields the hydrazine positive ion, which was studied by ESR. The complex is planar, symmetry D_{2h}, with the unpaired electron delocalized over the two nitrogen nuclei, which have the axial hyperfine coupling tensor $A_N = (2.5, 2.5, 27.6)$ G, $a_N = 11.0$ G. The principal components of the proton coupling tensors are $A_H = (+2, -20.6, -13.0)$ G, $a_H = -10.4$ G. The relative signs of the latter principal elements were ascertained by comparing experimental and calculated spectra, for orientations of the crystal where $\Delta M_I = 1$ transitions are observed. The radical had a different orientation in the crystal compared with that of the parent ion. The reorientation is thought to be due to the influence of the hydrogen bonds between the hydrazine positive ions and neighboring oxygen atoms. (auth)

42756 ESTIMATES OF OZONE YIELDS IN PROPOSED CHEMONUCLEAR REACTORS. Sears, John T.; Sutherland, James W. (Brookhaven National Lab., Upton, N. Y.). Nucl. Appl., 5: 62-3(Aug. 1968).

The efficiency of ozone synthesis from oxygen in a chemonuclear reactor is estimated as a function of temperature, ozone concentration, and dose rate from extrapolation of previous experimental results obtained with ^{60}Co gamma irradiation. The extrapolations give $G(O_3) \gtrsim 9$ for conditions closely approximating those cited by economic analysis as potentially interesting. Fission-fragment irradiation experiments give $G(O_3) \approx 6$ at T = −78°C for $[O_3]$ up to 0.45 vol %, in reasonable agreement with the extrapolations. (auth)

42757 RADIOLYSIS OF LIQUID HYDROCARBONS: DEPENDENCE OF THE FREE-ION YIELD ON MOLECULAR STRUCTURE. Tewari, P. H.; Freeman, G. R. (Univ. of Alberta, Edmonton). J. Chem. Phys., 49: 954-5(July 15, 1968).

The yields of free ions, G_{fi}, in the γ-radiolysis of liquid hydrocarbons have been interpreted in terms of two recent models. The difference between these models is discussed and results of further experiments reported. The yields of free ions from the γ-radiolysis of 2,2-dimethylbutane and 2,2-dimethylpropane were determined. The radiolyses of n-pentane, n-hexane, and cyclohexane were also studied to provide a direct comparison with the results from the more nearly spherical compounds (2,2,-dimethylbutane and 2,2-dimethylpropane). The experimental techniques consisted of the measurement of the ion mobilities of the radio-induced electrical conductance of the liquids. The yields of free ions in n-hexane and cylcohexane were virtually the same as previously reported. The n-pentane yield was nearly the same as that in n-hexane, as expected. However, the free-ion yields in 2,2-dimethylbutane and 2,2-dimethylpropane were relatively much larger, the largest being obtained for the compound with the most nearly spherical molecules. Possible explanations of these results are presented. (D.H.M.)

42758 CHEMICAL ENRICHMENT OF MERCURY ISOTOPES BY NEUTRON IRRADIATION OF DIPHENYLMERCURY IN SOLUTION. Collins, K. E.; Collins, C. H. (State Univ. of New York, Buffalo). Nucl. Appl., 5: 140-4(Sept. 1968).

Radiomercury was obtained by means of the Szilard–Chalmers effect with enrichment factors in excess of one thousand for short irradiations. The mercury activity is deposited on polyethylene surfaces from neutron irradiated solutions of diphenylmercury. The enrichment factor and yield were measured for several choices of solvent, solution concentration, irradiation dose, and post-irradiation storage time. (auth)

42759 RADIATION GRAFTING OF ACRYLONITRILE VAPOR TO SYNTHETIC CHLORINATED FIBER. Usmanov, Kh. U.; Tillaev, R. S.; Musaev, U. N.; Tursunov, Dzh. (Tashkent State Univ.). Dokl. Akad. Nauk Uzb. SSR, No. 11, 26-8(1967). (In Russian).

Radiation grafting of vapor phase acrylonitrile to synthetic chlorinated fiber was carried out in a γ installation using expanded chlorinated fiber No. 10 with viscosity in dichloroethane at 25°C equal to 0.68. Molecular weight $(\eta) = 5.6 \times 10^{-4} M^{0.67} =$ 38,900. The chlorine content was 62%. The acrylonitrile monomer was treated at 78 to 79°C ($N_D^{20} = 1.333$). Tabulated data on the physicomechanical properties of polymerized copolymers show that the breakage strength of the fiber remained unchanged after polymerization but the initial length of the fiber increased almost two fold without weakening the fiber. (R.V.J.)

42760 SAFETY IN THE CHEMICAL LABORATORY. L. THE DISPOSAL OF CHEMICAL RADIOACTIVE WASTE. PART ONE. Pearsall, S. G.; Wilshusen, W. (Brookhaven National Lab., Upton, N. Y.). J. Chem. Educ., 45: A599-605(Aug. 1968).

Topics considered include: rules and regulations, knowledge of the site, toxicity and hazards of waste materials, chemical disposal, and dilution. (M.C.G.)

42761 RADIOCHEMICAL PRODUCTION IN AUSTRALIA. Boyd, R. E. (Australian Atomic Energy Commision). At. Energy Aust., 11: No. 2, 2-12(Apr. 1968).

Radiochemical production facilities in Australia are described. Outlines of processes are given for ^{24}Na, ^{42}K, ^{82}Br, ^{32}P, ^{64}Cu, ^{18}F, ^{51}Cr, ^{131}I, ^{197}Hg-labeled chlormerodrin, and ^{99m}Tc. Quality control and production planning are discussed. (M.C.G.)

42762 EFFECTS OF RADIATION ON CORN STARCH SOLS. Tyler, Barbara S.; Munno, Frank J.; Cadman, Theodore W. (Univ. of Maryland, College Park). Environ. Sci. Technol., 2: 628-32(Aug. 1968).

The effect of gamma radiation on the sedimentation and degradation of corn starch sols was investigated for doses between 10^2 and 10^6 rad. No enhancement of the sedimentation during a 1-hr period resulted from the irradiation. For higher doses, radiation decreased the degree of sedimentation although a progressive decrease in turbidity resulted as the dose increased. The observed reduction of turbidity was attributed to progressive degradation of the starch with increased doses. The steps and the degree of degradation were investigated spectrophotometrically using an iodine indicator and are analogous to those noted in chemical degradation studies. (auth)

42763 RADIOLYSIS OF SOLID OXALIC ACID AND AMMONIUM OXALATE INDUCED BY MIXED PILE AND ^{60}Co GAMMA RADIATION. Gal, O.; Petkovic, Lj.; Josimovic, Lj.; Draganic, I. (Brois Kidric Inst. of Nuclear Sciences, Vinca, Yugoslavia). Int. J. Appl. Radiat. Isotop., 19: 645-56(Aug. 1968).

The radiolysis of anhydrous and oxalic acid dihydrate and ammonium oxalate in the solid state by mixed pile and ^{60}Co γ-radiation was studied at doses up to ca. 1000 megaRADS, when about 50% decomposition occurred. Dosimetry for these purposes is discussed in detail, particularly for experiments performed in the pile core of the Vinča heavy water reactor. It was found that CO_2, CO, and H_2 are the gaseous products and their yields were determined. In aqueous solutions of irradiated solid samples glycollic and glyoxalic acid were found. The decomposition–dose curves, as well as the CO_2 dosage curves, follow first order kinetics in the region studied. Initial G(−oxalate) for mixed pile radiation are 8.3 and 3.0 for $H_2C_2O_4 \cdot 2H_2O$ and $(NH_4)_2C_2O_4 \cdot H_2O$, respectively. For ^{60}Co γ-radiation the corresponding values are 6.0 and 3.2. G-values for $H_2C_2O_4$ were between 7 and 10 for pile radiation and 7.0 for ^{60}Co γ-radiation. The experimental results indicate that oxalic acid dihydrate may be a useful chemical dosimeter for reactor radiation in the multi-megarad region. (auth) (UK)

42764 DECAY OF PbN_6 MONOCRYSTALS UNDER THE ACTION OF X RAYS. Zakharov, Yu. A.; Ryabykh, S. M.; Lysykh,

A. P. (Tomsk Polytechnic Inst., USSR). Kinet. Kataliz., 9: 679-81(May-June 1968). (In Russian).

The kinetics of the radiolysis of PbN_6 were studied; gas release and retention by the crystalline matrix were considered. Curves of the disintegration kinetics at room temperature were obtained for pure PbN_6 and for PbN_6 with 1.5 and 5% Ag^+ based on the amount of retained nitrogen recorded during dissolution of monocrystals. Additions of Ag^+ accelerated the radiolysis; however, the acceleration rate was not proportional to the amount of cocrystallized impurity. (R.V.J.)

42765 FORMATION OF PHENOL AND NITROGEN BY A NEGATIVE ION–MOLECULE CHAIN REACTION ON IRRADIATION OF GASEOUS BENZENE–NITROUS OXIDE MIXTURES. Rzad, Stefan J.; Warman, John M. (Carnegie-Mellon Univ., Pittsburgh). Contract AT(30-1)-2310. J. Phys. Chem., 72: 3013-17(Aug. 1968). (RRL-2310-229).

Irradiation of benzene vapor containing nitrous oxide (<10%) results in relatively large yields of phenol and nitrogen (G values as high as 23.6 and 30.5, respectively, being obtained). The addition of 0.3% sulfur hexafluoride to the system completely inhibits nitrogen and phenol formation, indicating the electron to be the primary precursor of both products. Carbon dioxide also inhibits the reaction suggesting the participation of the O^- ion in the mechanism. For a given benzene–nitrous oxide mixture, the yields of phenol and nitrogen increase with decreasing dose rate. The following mechanism is found to describe all of the data: $e + X^+ \xrightarrow{k_5}$; $e + N_2O \xrightarrow{k_1} N_2 + O^-$; $O^- + C_6H_6 \xrightarrow{k_2} C_6H_6O^-$; $C_6H_6O^- + N_2O \xrightarrow{k_4} C_6H_5OH + N_2 + O^-$; and $C_6H_6O^- + N_2O \xrightarrow{k_8} C_6H_6 + N_2 + O_2^-$, with $\sqrt{k_5/k_1} = 4.3 \times 10^{11}$ (molecule sec/cm^3)$^{1/2}$ and $k_4/k_8 = 7.3$. (auth)

42766 PULSE RADIOLYSIS STUDIES. XII. KINETICS AND SPECTRA OF THE CYCLOHEXADIENYL RADICALS IN AQUEOUS BENZOIC ACID SOLUTION. Wander, R.; Neta, P.; Dorfman, Leon M. (Ohio State Univ., Columbus). J. Phys. Chem., 72: 2946-9(Aug. 1968).

The pulse-radiolysis method was used to determine the optical absorption spectra of the cyclohexadienyl radicals of benzoic acid in aqueous solution. The kinetics of formation and decay were determined in a pressurized N_2O solution. The uv absorption bands and extinction coefficients are: $(OH)\dot{C}_6H_5COOH$: λ_{max} 347 mμ, ϵ_{347} 3600 ± 500 M^{-1} cm^{-1}; $(OH)\dot{C}_6H_5COO^-$: λ_{max} 330 mμ, ϵ_{330} 3600 ± 500 M^{-1} cm^{-1}; $(H)\dot{C}_6H_5COOH$: λ_{max} 352 mμ, ϵ_{352} 3700 ± 500 M^{-1} cm^{-1}. The values of the rate constants, at 25°C, are: $k = (4.3 \pm 0.8) \times 10^9$ M^{-1} sec^{-1} for $OH + C_6H_5COOH$; $2k = (1.2 \pm 0.4) \times 10^9$ M^{-1} sec^{-1} for $(OH)\dot{C}_6H_5COOH + (OH)\dot{C}_6H_5COOH$; $2k = (5 \pm 2) \times 10^8$ M^{-1} sec^{-1} for $(OH)\dot{C}_6H_5COO^- + (OH)\dot{C}_6H_5COO^-$. (auth)

42767 INVESTIGATION OF HOT HYDROGEN ATOMS AND RADIATION-INDUCED REACTIONS IN LIQUID METHYL PROPYL ETHER. Filatov, E. S. (Moscow State Univ.). Khim. Vys. Energ., 2: 195-201(May-June 1968). (In Russian).

The reactions of hot atoms and radioinduced reactions in methylpropyl ether were investigated in the liquid phase at 70°C. The hot hydrogen atoms and the ionizing particles were obtained by means of the nuclear reaction $^6Li(n,\alpha)T$. A proportional counter was used for recording the activity of the products containing tritium; the quantity of gaseous radiolysis products was determined by means of a sensitive katharometer. The radiochemical yields of the products in pure ether were (%): HT – 61; CH_3T – 3.5; C_2H_5T – 1.3; C_2H_3T – 0.3; C_3H_7T – 1; $C_3H_6TOCH_3$ (and $C_3H_7OCH_2T$) – 22.5; CH_2TOH – 1.3; C_2H_4TOH – 0.5; $CH_3COC_2H_4T$ (and $CH_2TOC_2H_5$) – 0.5; and substances containing the OT group ("mobile tritium") – 7.5. In the presence of 5×10^{-2} $\underline{M}$ I_2, the yield of HT is 44%, the yield of mobile tritium increases to 31%, and the yield of other products varies slightly. The ratio of $[CH_3T]/[CH_4]$ and $[C_2H_5T]/[C_2H_6]$ increases in the presence of 5×10^{-2} $\underline{M}$ iodine by 1.5 to 2 times, and the ratio $[HT]/[H_2]$ remains constant. The results are interpreted on the basis of a mechanism including the reaction of hot atoms and radical products. (tr-auth)

42768 REACTIONS OF TRITIUM RECOILS IN BENZENE–IODINE AND BENZENE–BROMINE SYSTEMS. Avdonina, E. N. (Moscow State Univ.). Khim. Vys. Energ., 2: 202-5(May-June 1968). (In Russian).

The yields of the basic labeled products from the stabilization of tritium recoil atoms, obtained by the reaction $^6Li(n,\alpha)T$ in benzene containing additions of bromine and iodine in quantities up to 0.1 mol/l, were measured. It was shown that with increase of the concentration of the bromine and iodine, the HT yields are not affected. The yield of labeled benzene increases because of the corresponding reduction of the activity of high-boiling fractions, and these changes in mixtures of benzene with iodine were significantly stronger. The addition-induced inhibition of the formation of high-boiling labeled compounds depends linearly on the concentration of the addition to the $^2/_3$ degree, which suggests the important role of the excitation transfer process for stabilization of the tritium recoil atoms in these systems. (tr-auth)

42769 KINETICS OF THE FORMATION OF POLYMER FILMS FROM THE GASEOUS PHASE UNDER THE ELECTRON BOMBARDMENT OF METAL SURFACES. Tsapuk, A. K.; Kolotyrkin, V. M.; Butaev, A. M.; Tunitskii, N. N. (Karpov Physico-Chemical Inst., USSR). Khim. Vys. Energ., 2: 233-8(May-June 1968). (In Russian).

Thin polymer films of cyclotetrasiloxane were obtained on metallic surfaces by the electron bombardment method. The kinetics of their formation were investigated. It was found that the thickness of the films is proportional to the irradiation time. The rate of formation of the films decreases with the increase of the electron energy in the region from 250 to 750 V and is proportional to the square root of the current density. The dependence of the rate of growth of the films on the gas pressure is described well by the empirical expression $r = 10^5 p/(a + 10^5 bp)$. The infrared spectra were obtained and the specific resistance, rupture stress, and dielectric permeability of the films were evaluated. (tr-auth)

42770 INVESTIGATION OF RADIATION STABILITY OF SOME PARTIALLY HYDROGENATED POLYPHENYLS. Baroni, E. E.; Barabadze, K. V.; Elistratov, N. P.; Kovyrzina, K. A.; Makoveev, E. A.; Rozman, I. M.; Ryukhin, Yu. A.; Timoshenko, N. M. Khim. Vys. Energ., 2: 239-43(May-June 1968). (In Russian).

The radiation stability of five partially hydrogenated terphenyls and two partially hydrogenated tetraphenyls was investigated. The results of the determination of the radiation yields of gases and "polymers" were reported. The radiation stability of the cyclohexylbiphenyl is close to the radiation stability of terphenyls. (tr-auth)

42771 EFFECTS OF THE DOSE RATE ON FIXED CONCENTRATIONS IN RADIOLYSIS. Ershler, B. V. (Inst. of Theoretical and Experimental Physics, Moscow). Khim. Vys. Energ., 2: 244-8(May-June 1968). (In Russian).

It was shown that the $I^{1/2}$ rule for the fixed concentration does not depend on parameters of the radiolysis that are determined by definite mechanisms that were reported earlier. It was noted that the parameter p, determining the $I^{1/2}$ rule for fixed concentrations and for the radiolysis kinetics, was found from the relation $p = N - 1$, where N is the number of atomic varieties introduced into the composition of the solvent molecule and all particles reacting in the irradiated solution. It was also noted that the $I^{1/2}$ rule for fixed concentrations does not depend on the nature of the solvent and the radiolysis mechanism. (tr-auth)

42772 INVESTIGATION OF RADIOLYSIS MECHANISM OF AQUEOUS BENZENE SOLUTION IN THE PRESENCE OF HYDROGEN PEROXIDE. Zhikharev, V. S.; Vysotskaya, N. A. (Pisarzhevsk Inst. of Physical Chemistry, Moscow). Khim. Vys. Energ., 2: 249-53(May-June 1968). (In Russian).

The investigation of the radiolysis of aqueous solutions of benzene in the presence of $H_2{}^{18}O_2$ showed that part of the oxygen in the phenol being formed contains ^{18}O. The radiation yields for the formation of phenol and for the consumption of hydrogen peroxide were measured at different pH. The data obtained were explained by the decomposition of hydrogen peroxide during the reaction with e^-_{aq} with formation of the OH radical and interaction of the latter with benzene, in agreement with the Proskurnin and Dorfman mechanisms. The fraction of ^{18}O, transferred from the hydrogen peroxide to the phenol, was calculated and good agreement was obtained between the calculated and experimental values. (tr-auth)

42773 RADIOLYSIS OF AQUEOUS SOLUTIONS OF TYROSINE, CONCENTRATION, AND OXYGEN EFFECTS. Brodskaya, G. A.; Sharpatyi, V. A. (Inst. of Chemical Physics, Moscow. Inst. of Nuclear Physics, Tashkent). Khim. Vys. Energ., 2: 254-7(May-June 1968). (In Russian).

The kinetics of the radiolysis of tyrosine and the formation of NH_3, carbonyl compounds, H_2O_2, and H_2 during radiolysis of 0.0001 to 0.1$\underline{M}$ aqueous solutions of tyrosine were investigated at different pH. The effect of O_2 on these processes was studied. The role of the primary products of the water radiolysis in the radiation-chemical processes, occurring in the tyrosine–water system, was considered. (tr-auth)

42774 PARTICIPATION OF THE SURFACE RADICALS OF SILICA GEL IN THE RADIO-INDUCED REACTIONS WITH ADSORBED BENZENE. Strelko, V. V.; Suprunenko, K. A. (Pisarzhevsk Inst. of Physical Chemistry, Moscow). Khim. Vys. Energ., 2: 258-62(May-June 1968). (In Russian).

The effect of γ radiation on the benzene–silica gel system was investigated by the EPR method at different ratios of the components. The chemical interaction during irradiation between the surface radicals Si–O˙ of the silica gel and benzene was established. The interaction was detected by measurement of the intensity of the spectral lines of the Si–O˙ radicals as a function of the degree of saturation of the surface with benzene. The investigations were made with ordinary and deuterated silica gel. (tr-auth)

42775 SOLUTION OF IRRADIATED CRYSTALS OF STRONTIUM SULFATE IN WATER. Gromov, V. V.; Bespalova, T. N. (Inst. of Physical Chemistry, Moscow). Khim. Vys. Energ., 2: 263-7(May-June 1968). (In Russian).

It was shown that the rate of dissolution of β-radioactive and γ-irradiated crystals of strontium sulfate, containing only electron defects (the ion–radicals SO_4^-, SO_3^-), decreases to the extent of the increase of the concentration of defects. The displacement of atoms in the crystalline lattice during neutron bombardment causes an increase of the dissolution rate. Thermal processing of the defects of the crystals, as a result of which annealing of the radiation dislocations occurs, leads to an increase of the dissolution rate of γ-irradiated and radioactive crystals. An empirical dependence between the dissolution rate constant and the concentration of the electron defects was obtained. (tr-auth)

42776 INVESTIGATION OF HETEROGENEOUS RADIOLYSIS OF WATER BY MEANS OF EXOELECTRONIC EMISSION. Krylova, I. V.; Krylova, Z. L. (Moscow State Univ.). Khim. Vys. Energ., 2: 268-70(May-June 1968). (In Russian).

Centers of delayed electron emission were formed under the effects of γ radiation on silica gel. These centers can be filled repeatedly by electron bombardment and can be destroyed by subsequent annealing to 400°C. In the presence of adsorbed water the electron emission centers are not formed. The absence of EPR signals under these conditions indicates that the emission centers are defects having EPR signals. (tr-auth)

42777 CHANGE OF THERMOLUMINESCENCE OF IRRADIATED POLYETHYLENE UNDER ILLUMINATION BY MONOCHROMATIC LIGHT. Nikol'skii, V. G. (Inst. of Chemical Physics, Moscow). Khim. Vys. Energ., 2: 271-3(May-June 1968). (In Russian).

The illumination by monochromatic light of polyethylene samples, first irradiated with fast electrons at 77°K, decreases the intensity of the thermoluminescence up to some limiting value. This limiting value depends only on the wave length of the light incident on the sample. It was noted that the irradiated polyethylene does not contain charges, captured in finely divided additions, from which they can be eliminated by thermal activation. (tr-auth)

42778 A NEW DETERMINATION METHOD OF RELATIVE RATE CONSTANTS FOR REACTIONS WITH OH-RADICALS IN RADIOLYSIS OF AQUEOUS SOLUTIONS. Morita, Makio; Fujimaki, Masao (Tokyo Univ.). Bull. Chem. Soc. Jap., 41: 1109-12(May 1968).

Radioactivity of water increased linearly with dose when aqueous solution of ^3H-formate (2 μCi/ml and 2×10^{-3} $\underline{M}$) was irradiated with γ-rays in the presence of oxygen. The increase of the radioactivity was found to be reciprocally proportional to the non-labeled formate concentration where the amount of ^3H-formate was kept invariable. Addition of ferrocyanide and 2-propanol, effective OH-radicals scavengers, depressed the radioactivity increase to near zero. These facts show that the abstraction of tritium from ^3H-formate by OH-radicals causes the increase of the radioactivity of water. A competition method to measure relative rate constants for reactions with OH-radicals was devised on the present results. Some values obtained by this method were in agreement with published data. (auth)

42779 EXTINCTION COEFFICIENTS OF TRIPLET–TRIPLET TRANSITIONS. Land, E. J. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Proc. Roy. Soc. (London), Ser. A, 305: 457-71(July 23, 1968).

A method for determining these coefficients was developed. The method employs pulse radiolysis for triplet excitation and, by means of triplet–triplet (T–T) energy transfer, led to a comparison between the extinction coefficients of the benzophenone ketyl radical ($\phi_2\dot{C}OH$) and the triplet states of several aromatic compounds whose triplet levels are lower than that of benzophenone. Since the ketyl extinction coefficient could be determined independently, the actual T–T extinction coefficients could be obtained. Values of the extinction coefficient at the absorption maximum were obtained for anthracene (57,200 $\underline{M}^{-1}$ cm^{-1}), naphthalene (22,600 $\underline{M}^{-1}$ cm^{-1}), phenanthrene (21,000 $\underline{M}^{-1}$ cm^{-1}), and 1,2-benzanthracene (25,100 $\underline{M}^{-1}$ cm^{-1}), all relative to an extinction coefficient for the benzophenone ketyl maximum around 540 nm determined to be 3220 $\underline{M}^{-1}$ cm^{-1}. For several other compounds the method, for various reasons, could not be applied. In such cases estimates were obtained by energy transfer experiments, leading to comparisons between their triplet absorptions and those of the compounds already determined. Estimates were thus obtained for the maximum T–T extinction coefficients of benzophenone (10,300 $\underline{M}^{-1}$ cm^{-1}), biacetyl (6400 $\underline{M}^{-1}$ cm^{-1}), diphenyl (35,400 $\underline{M}^{-1}$ cm^{-1}), and acridine (28,800 $\underline{M}^{-1}$ cm^{-1}). During the course of these experiments estimates were also obtained for the rates of the following reactions: $e^-_{aq.}$ + benzophenone ($k_{II} = 3.0 \times 10^{10}$ $\underline{M}^{-1}$ s^{-1}), OH˙ + benzophenone ($k_{II} = 8.7 \times 10^9$ $\underline{M}^{-1}$ S^{-1}), and hydrogen abstraction by triplet benzophenone from cyclohexane, to give $\phi_2\dot{C}OH$ ($k_{II} \sim 8 \times 10^5$ $\underline{M}^{-1}$ S^{-1}). (auth) (UK)

42780 THERMAL DECOMPOSITION OF IRRADIATED LEAD NITRATE. Mohanty, S. R.; Ray, M. N. (Banaras Hindu Univ., India). Indian J. Chem., 6: 319-23(June 1968).

The role of defects generated by irradiation in the thermal decomposition of crystalline lead nitrate is investigated. The decomposition follows the Prout–Tompkins law. Irradiation enhances the decomposition rate, the effect increasing with dose. The activation energies are, however, not appreciably affected by irradiation. Post-irradiation annealing tends to restore the decomposition characteristic of the original unirradiated substance. It is considered that the chemical damage species produced by irradiation constitute decomposition nuclei and are responsible for the higher thermal decomposition of the irradiated substance. (auth)

42781 YIELD OF HYDROGEN ATOMS IN THE VAPOR PHASE RADIOLYSIS OF AMMONIA. Nishikawa, Masaru; Kuroda, Kazufumi; Matsuura, Niro (Tokyo Univ.). Bull. Chem. Soc. Jap., 41: 1276(May 1968).

Results of a study of the γ-radiolysis of the $NH_3-C_3H_8$ system are reported. The total hydrogen yield calculated for the energy absorbed in the ammonia fraction increased from $G(H_2) = 4.1$ to 7.8 at the propane concentration of 8.6 mol %. No plateau was reached up to this concentration, suggesting hydrogen formation from the direct radiolysis of the propane fraction. Therefore, in order to estimate the contribution of the propane fraction for the observed yield of hydrogen, G-values of total hydrogen yields (G_t) were calculated for the total energy absorbed by the system ($E_t = E_a + E_p$) and when plotted against the fraction of energy absorbed in propane ($f_p = E_p/E_t$) a good straight-line relationship was demonstrated for f_p below 0.13 regardless of density or temperature and extrapolation to $f_p = 0$ yields $G(H_2) = 5.84$. The yield of hydrogen at $f_p = 0$, $G(H_2) = 5.84$, is therefore a measure of the total yield of hydrogen atoms and the molecular hydrogen from the radiolysis of ammonia vapor. The latter is known to be 0.74 hence, $G_H = 5.10$. (D.H.M.)

42782 HYDROGEN FORMATION IN THE RADIOLYSIS OF LIQUID OLEFINS. THE ROLE OF HOT HYDROGEN ATOMS AND SUPEREXCITED STATES. Hatano, Yoshihiko; Shida, Shoji; Sato, Shin (Tokyo Inst. of Tech.). Bull. Chem. Soc. Jap., 41: 1120-5(May 1968).

The γ-radiolysis of liquid olefins was undertaken to obtain reliable evidence for a possible role of hot hydrogen atoms and superexcited states in radiation chemistry. The contribution of thermal hydrogen atoms may reasonably be excluded in this system. The effect of various electron or positive-ion scavengers on hydrogen formation in the radiolyses of liquid propylene and ethylene was examined. The hydrogen formation is not appreciably affected by these additives, which indicates ionic species may not play an important role in the hydrogen formation. The liquid-phase radiolyses of $C_3H_6-C_3D_6$ and $C_2H_4-C_2D_4$ mixtures were also investigated and compared with those previously reported of C_4H_8-1 –C_4D_8-1 and trans-C_4H_8–2-trans-C_4D_8-2 mixtures. The data indicate that the hydrogen from the olefins except ethylene may be formed for the most part by bimolecular processes. A large part of the hydrogen from liquid ethylene may be interpreted in terms of the molecular detachment of a hydrogen molecule, while from the other olefins it may be interpreted in terms of the hydrogen-atom abstraction reaction of hot hydrogen atoms formed by direct excitation which must at least partially involve superexcitation. To attempt quantitative substantiation of the above viewpoint a simple calculation has been made based on the so-called optical approximation. Calculated yields of the hydrogen formation are apparently in good agreement with observed ones. (auth)

42783 POLYANIONS AND THEIR COMPLEXES. PART V. EXAMINATION OF POLYANION–CATION INTERACTION USING PULSE RADIOLYSIS. Balazs, E. A. (Inst. of Biological and Medical Sciences, Boston); Davies, J. V.; Phillips, G. O. J. Chem. Soc., C, No. 12, 1429-33(1968).

Changes in e^-_{aq} reaction rate with methylene blue and acridine orange, following the addition of polyanion, demonstrates that interaction occurs in aqueous solution between these metachromatic dyes and hyaluronic acid, sodium poly(ethylenesulphonate), sodium poly(styrenesulphonate), heparin, and DNA. The changes are reversed on addition of sodium chloride and methanol and on increase in temperature. These agents are known to destroy the interaction and reverse the metachromatic shift. Interaction can also be demonstrated with methyl green, which is a nonmetachromatic dye. The method was extended to study the interaction between cetyl pyridinium chloride, the polycations polylysine and protamine sulfate, and the polyanions HEP(heparin) and DNA before electrochemical equivalence and consequently precipitation occurred. Ion-binding due to the formation of contact ion-pairs, formed unusually in water as a result of the high electrostatic potential on the surface of the macroion, adequately accounts for the results. (auth) (UK)

42784 DIELECTRIC SATURATION EFFECT IN THE CONTINUOUS DIELECTRIC MODEL FOR THE SOLVATED ELECTRON. Fueki, Kenji (Nagoya Univ., Japan). J. Chem. Phys., 49: 765-7(July 15, 1968).

The effect of dielectric saturation on the electronic properties of solvated electrons was considered within the framework of the continuous dielectric model with the adiabatic approximation. An approximate potential energy function including dielectric saturation was derived for the solvated electron in water. A calculation was made of the energy levels, the transition energy, and the charge distribution of the hydrated electron on the basis of this potential energy function. (auth)

42785 THERMOLUMINESCENCE OF SOME IRRADIATED POLYMERS. Mozisek, Max (Research Inst. of Tech. of Rubber and Plastics, Gottwaldov, Czech.). Jad. Energ., 14: 198-200(May 1968). (In Czech).

Studies were made of thermoluminescence of polymers exposed to ionizing radiation at −196°C. Polyethylene and polypropylene exhibited a very high level of radiosensitivity. The area under the thermoluminescence curve is proportional to the absorbed doses and the curve peaks correspond to the regions of incremented release of parts of the macromolecules. The data for thermoluminescence curves of the polymers examined are not conclusive. (tr-auth)

42786 INFLUENCE OF ^{60}Co γ RADIATION ON THE ISOTOPIC EXCHANGE IN MOLECULAR OXYGEN–NEODYMIUM OXIDE SYSTEM. Minachev, Kh. M.; Antoshin, G. V.; Mashkevich, A. Ya.; Lokhuaru, M. E.; Dmitriev, R. V. (Inst. of Organic Chemistry, Moscow). Dokl. Akad. Nauk SSSR, 180: 364-6(May 11, 1968). (In Russian).

Catalytic properties of neodymium oxide placed in the field of a strong γ source were studied and γ-radiation effects on isotopic exchange in molecular oxygen were investigated. A molecular mixture of $^{16}O^{16}O$, $^{16}O^{18}O$, and $^{18}O^{18}O$ with a total concentration of 15.5 at. % ^{18}O was used. The magnitude of the apparent activation energy of the reaction $^{16}O_2 + {}^{18}O_2 \rightarrow 2\ {}^{16}O^{18}O$ on the neodymium oxides under irradiation at 220 to 100°C was 6.5 kcal/mole. At close to room temperature the lifetime of the centers formed was long enough and their activity increased with increasing dose. The effect remained after irradiation was discontinued. (R.V.J.)

42787 TRITIUM TRACING OF ORGANIC COMPOUNDS. I. THE ISOTOPE EXCHANGE INDUCED BY RADIATIONS AND EXCITATION. Mantescu, C.; Bratu, C. Stud. Cercet. Chim., 15: 575-602(1967). (In Rumanian).

A brief comparison is drawn between synthetic and nonsynthetic tritium-tracing methods. Radioinduced isotope exchange and excitation isotope exchange, known as Wilzbach and "modified" or "accelerated" Wilzbach methods, were investigated. (Rom. Sci. Abstr.)

42788 EFFECT OF IONIZING RADIATION ON FATS. VIII. FORMATION OF WATER IN OILS AND FATS INDUCED BY IRRADIATION. Kohn, R. (Deutsche Forschungsanstalt fuer Lebensmittelchemie, Munich). Fette-Seifen-Anstrichm., 69: 323-5 (May 1967). (In German).

Irradiation of groundnut oil and lard with γ rays from a ^{60}Co source led, depending on the irradiation dose (10^4 to 10^8 RAD), to formation of free water, which was measured by Karl-Fischer method. The formation of water in fats can be explained on the basis of currently accepted conceptions of radiolytic decomposition of esters, fatty acids, hydroperoxides, and alcohols. (auth)

42789 UTILIZATION OF ENERGY OF FISSIONABLE ELEMENTS IN CHEMICAL CONVERSIONS. (to Socony Mobil Oil Co., Inc.). French Patent 1,280,619. Filed Oct. 28, 1960.

A structure is described for utilizing the energy of nuclear fission elements in performing chemical reactions. It consists of a porous mass made up of at least one body of inorganic solid contact material that contains dispersed fissionable material in controlled concentration sufficient to render the mass, in an environment comprising a confined zone and under selected chemical conversion conditions, including neutron moderation and in the presence of neutron flux, capable of effecting a neutron-multiplying fission reaction. The mass is receptive to a fluid reactant feed material, whereby production of a moderated neutron flux in the mass will promote fission at a rate at least sufficient to supply the energy required for effecting a conversion of the reactant material to desired products. The size and shape of the body of contact material is such as will ensure initial retention within the mass of substantially all of the normally solid fragments released by fission. Various preferred forms of the structure and many typical chemical conversions to which the method may be applied are given. (NPO)

42790 EPR DETECTION OF THE HYDRATED ELECTRON IN LIQUID WATER. Avery, E. C.; Remko, J. R.; Smaller, B. (Argonne National Lab., Ill.). J. Chem. Phys., 49: 951(July 15, 1968).

The EPR spectrum of free radicals produced by pulsed electron irradiation of aqueous solutions of methanol contains a line in addition to those of the methanol radical. The paramagnetic characteristics, together with the effects of alteration of the chemical environment, led to identification of this free spin species as the hydrated electron. The transient signal, with a lifetime of the order of 10 msec, appears in the spectrum as a single narrow line near g = 2. It is quenched in acid solution and increases in intensity in basic solution with a maximum between pH 11 and 12. This resonance was not detected on irradiation of the pure alcohol. The single species was observed in CH_3OH in D_2O, CD_3OD in D_2O, and C_2D_5OD in D_2O. The addition of oxygen, carbon dioxide, nitrous oxide, or acetone, in concentrations too low to affect the alcohol radical, completely quenched the resonance. Relative to the methanol radical ($g = 2.00334$) the hydrated electron resonance has $g = 2.0002 \pm 0.0002$ and linewidth less than 0.5 G at 5°C. The linewidth measurement is limited by field inhomogeneity; the true value may well be less than 0.1 G. (D.H.M.)

42791 RADIOCHEMICAL PREPARATION OF ION-EXCHANGE MATERIALS. Egorov, E. V. (All-Union Scientific Research Inst. for Chemistry Reagents and Highly Pure Chemistry, Moscow). Russ. Chem. Rev. (Engl. Transl.), 36: 536-45(July 1967).

The preparation of ion-exchange materials by use of ionizing radiation is one of the few radiochemical processes that has found definite practical application. Homogeneous ion-exchange membranes were obtained by grafting certain monomers on to various polymer carriers under the influence of radiation. These membranes have distinct advantages over those prepared by ordinary chemical methods. Moreover, ion-exchange resins prepared by the radiochemical method are in some instances not only better, but also cheaper, than ordinary standard ion exchangers. The methods of radiation polymerization, copolymerization, and grafting make it possible to prepare materials that differ from ordinary materials in their high purity, improved physicomechanical characteristics, and other valuable properties influencing their performance. Grafting by infrared radiation makes it possible to obtain graft copolymers whose preparation is difficult or impossible by ordinary chemical methods. These copolymers can be used to prepare ion-exchange membranes with high mechanical strength, high selectivity, and low electrical resistance. Preparation of membranes, resins, fibers, fabrics, paper, and mineral-organic sorbents is discussed. The last technique involves radiochemical preparation of typical exchange functionalities on an inorganic backbone. Mineral-organic ion exchangers also have a high radiochemical stability. (BBB)

42792 ALPHA-PARTICLE-EXCITED FLUORESCENCE OF ^{241}Am-DOPED Eu^{3+} AND Tb^{3+} CHELATES. Karraker, D. G. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Contract AT(07-2)-1. J. Chem. Phys., 49: 957-8(July 15, 1968). (DP-MS-67-91).

Synthesis of the chelates $(C_2H_5)_3NHEu(DPPD)_4$ (where DPPD = 1,3-diphenyl-1,3-propanedione) and $Tb(thd)_3$ (where thd = 2,2,6,6-tetramethyl-3,5-heptanedione) with the substitution of ^{241}Am for a fraction of the lanthanide ion produces a mixed chelate that fluoresces brightly from excitation by the alpha decay of ^{241}Am. The spontaneous emission spectrum of the ^{241}Am-doped Eu^{3-1} chelate was identical with the ultraviolet-excited spectra of the pure Eu^{3-1} chelate. The pure lanthanide chelates fluoresce visibly when mechanically mixed with ^{241}Am compounds, but do not fluoresce in a gamma field of about 200 mR/h. No fluorescence was observed from pure $(C_2H_5)_3NHAm(DPPD)_4$ or $Am(thd)_3$. Americium-241-doped chelates did not change significantly in appearance or solubility for 2 to 3 days, but after one week they were discolored and were no longer completely soluble in benzene. The α-excited fluorescence of the 1/9 Am : Eu chelate was about 20% as intense as the ultraviolet-excited fluorescence. The observed spectra and relative intensity of each line for $(C_2H_5)_3NHEu(Am)(DPPD)_4$ are given. (D.H.M.)

42793 GAMMA-RAYS INDUCED CONDUCTIVITY IN INSULATING POLYMERS. III. Furuta, Junichiro; Hiraoka, Eiichi; Okamoto, Shinichi. Annu. Rep. Radiat. Center Osaka Prefect., 8: 95-9(1967).

A vacuum metal box was improved with a hot water tank around it and it had large thermal inertia. The temperature of the sample was maintained within the fluctuation of ± 0.1°C for a long time. The temperature dependence of induced currents for polyethylene and polytetrafluoroethylene was investigated. The shapes of growth curves for polyethylene changed at the temperature greater than 80°C. But for polytetrafluoroethylene, the shapes did not change at the temperature between room temperature and 91°C. In decay curves of polytetrafluoroethylene, decay time constants did not change in this temperature region. For polyethylene, the decay time constants depended on temperature. (auth)

42794 ESR OF IRRADIATED CALCIUM NITRATE ICE. Kawabata, Keisuke; Okabe, Shigeru; Taniguchi, Setsuo. Annu. Rep. Radiat. Center Osaka Prefect., 8: 66-9(1967).

The primary intermediates produced in irradiated ice containing concentrated calcium nitrate were investigated with ESR. The species were H, NO_2, and NO_3 radicals and others. The appearance of these species at −196°C and changes at a few annealing temperature were observed. (auth)

42795 TEMPERATURE DEPENDENCE OF SOLVATED ELECTRON IN CONCENTRATED AQUEOUS SOLUTION OF ALKALI. Kawabata, Keisuke; Okabe, Shigeru; Fujita, Shinichi; Horii, Hideo; Taniguchi, Setsuo. Annu. Rep. Radiat. Center Osaka Prefect., 8: 70-3(1967).

Using pulse radiolysis techniques, the solvated electron produced in aqueous solutions of $5\underline{M}$ KOH – $5\underline{M}$ NaOH was examined over a wide temperature region from 20 to −78°C, in the lower part of which the medium is solidified. The optical absorption spectrum shifted to shorter side as temperature decreased and at −78°C the peak was around 6000 Å, which almost approached that of the trapped electrons measured at −196°C. The activation energy of the decaying rate was 0.54 eV below −20°C, which nearly agrees with the activation energy of the electric conductivity of this medium. The two, slow and fast, decaying components of solvated electron were observed below −40°C. Temperature dependence of the optical absorption just after the pulse was also measured. (auth)

42796 EFFECT OF β RADIATION ON THE FLOTATION BEHAVIOR OF MINERALS OF THE RARE EARTHS. Chanturiya, V. A.; Shafeev, R. Sh.; Yakushkin, V. P. Izv. Vyssh. Ucheb. Zaved., Tsvet. Met., No. 2, 3-7(1968). (In Russian).

The effect of β radiation on the flotation behavior of pyrochlore, zircon, ilmenite, ilmenorutile, rutile, and quartz was investigated. The possibility of selective separation of pyrochlore from zircon by the use of β radiation was shown. The decrease of the flotation activity of quartz and zircon was shown by the displacement of the total potential values to the very negative side after their irradiation. The decrease of the extraction of ilmenite, ilmenorutile, and rutile was explained basically by the effects of electrons on the solid phase. An increase of the concentration of electrons leads to an increase of the absorptive activity of the minerals with respect to the sorbent after irradiation. (tr-auth)

42797 RADIATION-GENERATED OZONE AND NITROGEN OXIDES IN TECHNICAL AND LIQUEFIED GASES. Dmitriev, M. T. Zh. Prikl. Khim., 41: 39-43(1968). (In Russian).

Data are cited that make it possible to determine the concentration of ozone and nitrogen oxides that form in technical and liquefied gases subjected to irradiation as a function of the dose, dose rate, gas pressure, and concentration of impurities. These data can be utilized in evaluating the corrosion of reactor materials, in selecting anticorrosion materials and in calculating the effectiveness of ventilation and mixing. It can also be used in calculating the levels of the additional consumption of liquid gases required to evaporate the coolant residue and to disconnect the cooling unit that would make it possible to prevent the formation of explosive mixtures during irradiation. (ATD)

42798 RADIOCHEMICAL DIMERIZATION OF ACENAPHTHYLENE IN THE SOLID STATE. Chapiro, Adolphe; Lozach, Guy (CNRS, Bellevue, France). Compt. Rend., Ser. C, 267: 37-9 (July 1, 1968). (In French).

The dimerization of crystalline acenaphthylene under gamma irradiation was studied at different temperatures. The speed of the reaction was independent of the temperature between 71 and 20°C. At lower temperatures the reaction has an activation energy of 7 kcal/mole. (tr-auth)

42799 PULSE RADIOLYSIS. Schneider, Christel (Univ., Cologne). Naturwissenschaften, 55: 197-205(May 1968). (In German).

Pulse radiolysis is the radiation-chemical analog to flare photolysis developed by Norrish and Porter. A bibliographic review is given of the development of this method. Apparatus and measurement techniques used are described. The most important pulse radiolytic studies made on water and water systems and organic materials are outlined. (59 references). (J.S.R.)

42800 LIQUID HEXANE. Gaeumann, Tino (Institut de Chimie-Physique de l'EPUL, Lausanne, Switzerland). pp 213-56 of Aspects of Hydrocarbon Radiolysis. Gaeumann, T.; Hoigne, J. (eds.). London, Academic Press, Inc., (London) Ltd., 1968.

Methods for the analysis of products of the radiolysis of hexane are discussed. Results of recent investigations on the radiolysis of pure deuterated hexane and mixtures of deuterated and normal hexanes are reviewed. Possible reactions in the radiolysis of hexane are considered. (125 references) (J.G.B.)

42801 CYCLOHEXANE. Cramer, W. A. (Reactor Inst., Delft, Netherlands). pp 153-212 of Aspects of Hydrocarbon Radiolysis. Gaeumann, T.; Hoigne, J. (eds.). London, Academic Press, Inc., (London) Ltd., 1968.

Various aspects of the radiolysis of cyclohexane are considered. Results of studies on the mechanisms involved in radioinduced reactions in cyclohexane with and without additives are reviewed. Possible explanations of these results are indicated. (133 references) (J.G.B.)

42802 AROMATIC HYDROCARBONS. Hoigne, Juerg (Forschungs- und Bestrahlungszentrum, Schwerzenbach, Switzerland). pp 61-151 of Aspects of Hydrocarbon Radiolysis. Gaeumann, T.; Hoigne, J. (eds.). London, Academic Press, Inc., (London) Ltd., 1968.

The radiation chemistry of simple aromatic hydrocarbons at moderate temperatures and radiation doses is considered. Experimental methods are discussed and results are summarized and compared. (240 references) (J.G.B.)

42803 DOSE-RATE AND LINEAR ENERGY TRANSFER EFFECTS IN HYDROCARBONS. Burns, W. G. (Atomic Energy Research Establishment, Harwell, Eng.); Barker, R. pp 33-60 of Aspects of Hydrocarbon Radiolysis. Gaeumann, T.; Hoigne, J. (eds.). London, Academic Press, Inc., (London) Ltd., 1968.

The effects of variations in dose-rate and the Linear Energy Transfer (LET) parameter of the radiation in the radiolysis of liquid and gaseous hydrocarbons are reviewed. Transition dose-rates and predicted product distribution for an alkane are discussed. Possible origins of LET effects and result of LET effects in hydrocarbons are also discussed. (60 references) (J.G.B.)

42804 RADICAL YIELDS OF HYDROCARBONS. Holroyd, R. A. (Atomics International, Canoga Park, Calif.). pp 1-32 of Aspects of Hydrocarbon Radiolysis. Gaeumann, T.; Hoigne, J. (eds.). London, Academic Press, Inc., (London) Ltd., 1968.

Chemical methods for the measurement of free radical yields in the radiolysis of organic liquids are reviewed. Radical yields from the radiolysis of alkanes are summarized in detail. (92 references) (J.G.B.)

42805 ASPECTS OF HYDROCARBON RADIOLYSIS. Gaeumann, T.; Hoigne, J. (eds.). London, Academic Press, Inc., (London Ltd.), 1968. 279p. 70s.

Five chapters are included; separate abstracts have been prepared for each. (J.G.B.)

For abstracts of individual chapters see: 42800–42804.

Radiochemistry

Refer to abstracts 43301 and 43935.

Separation Processes

Refer also to abstracts 42725, 42874, and 43556.

42806 (ANL-7412) LABORATORY INVESTIGATIONS IN SUPPORT OF FLUID-BED FLUORIDE VOLATILITY PROCESSES. PART XIX. REACTION OF BROMINE PENTAFLUORIDE WITH SELECTED COMPOUNDS OF URANIUM AND PLUTONIUM. Jarry, R. L.; Stockbar, J. J.; Steindler, M. J. (Argonne National Lab., Ill.). Mar. 1968. Contract W-31-109-eng-38. 43p. Dep. CFSTI.

The use of BrF_5 to selectively remove uranium from mixtures with plutonium was studied. The results show that uranium in mixtures with alumina, plutonium dioxide, and fission product compounds can easily be converted to UF_6 at 350°C or lower using 20% BrF_5 in nitrogen as the fluorinating gas while converting the plutonium only to the nonvolatile PuF_4. The presence of Zircaloy or stainless steel decladding product did not hinder the removal of uranium. Plutonium could be satisfactorily converted to PuF_6 by a second fluorination step at 500 to 550°C using elemental fluorine. The kinetics of the reaction of BrF_5 with UF_4, UO_2F_2, U_3O_8, UO_2, and UO_3 were determined; and activation energies of 16.9, 8.3, 9.2, 7.5, and 7.7 kcal/mole, respectively, were derived. Values of the coefficient n for the pressure term in the equation $k' = Ae^{-E/RT}p^n$ of 0.38, 0.71, 0.90, 0.84, and 1.05 were derived for the reactions with UF_4, UO_2F_2, U_3O_8, UO_2, and UO_3, respectively. (auth)

42807 (BNWL-759) EFFECTS OF SOME SYNERGISTIC AND ANTAGONISTIC AGENTS ON HDEHP EXTRACTION OF STRONTIUM. Schulz, Wallace W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). July 1968. Contract AT(45-1)-1830. 27p. Dep. CFSTI.

Bis(2-ethylhexyl) phosphate, HDEHP, diluted with TBP and kerosene, is used as the extractant in the Hanford B-plant to extract ^{90}Sr from various radioactive waste solutions. Process chemistry oriented studies were performed to determine the effects of various known and possible extractant components on extraction of strontium by the B-plant solvent. Small concentrations of TBP and of the more powerful synergist DBBP (dibutyl butylphosphonate) enhance extraction of strontium (synergistic effect). Conversely, small concentrations of either H_2MEHP [mono (2-ethylhexyl) phosphoric acid] or 2-ethylhexanol depress strontium distribution coefficients (antagonistic effect). Consequences of these observations to plant operation are discussed. (auth)

42808 (CEA-R-3435) REDUCTION OF OXIDES OF URANIUM AND PLUTONIUM BY ALUMINUM. APPLICATION TO THE RECYCLING OF PLUTONIUM. Gallay, Jean-Jacques (Commissariat a l'Energie Atomique, Valduc (France). Centre d'Etudes). Mar. 1968. 22p. (In French). Dep.

A process for treating plutonium oxide calcined at high temperatures (1000 to 2000°C) with a view to recovering the metal consists in the reduction of this oxide dissolved in a mixture of aluminum, sodium, and calcium fluorides by aluminum at about 1180°C. Results of reduction tests carried out on the uranium oxides UO_2 and U_3O_8 are presented; these are in agreement with the thermodynamic calculations of the exchange reaction at equilibrium. Application of this method to plutonium oxides is also described. The Pu-Al alloy obtained (60% Pu) is then recycled in an aqueous medium. (auth)

42809 (CONF-660553-8) PURIFICATION OF ORGANIC REACTOR COOLANTS. Hannaert, H.; Cardozo, R. Lopes (European Atomic Energy Community, Ispra (Italy). [Joint Nuclear Research Center]). [nd]. 46p. Dep. DTIE.

From Panel on Use of Organic Liquids as Reactor Coolants and Moderators, Vienna, Austria.

Methods are described for the purification of organic reactor coolants. These methods include: dechlorination with Ti-Zr alloys and by catalytic hydrogenation; deoxygenation with Attapulgus clay or by catalytic hydrogenation; and high boiler removal by distillation, specific precipitation, and liquid-liquid extraction. From the results, it was concluded that an optimal, integrated purification system for a future Orgel reactor could consist of a combined catalytic dechlorination/deoxygenation, followed by filtration and degasification. (P.C.H.)

42810 (EURFNR-471) ON THE DISSOLUTION OF BREEDER FUELS CONTAINING PuO_2 IN NITRIC ACID FOR AQUEOUS REPROCESSING BY THE PUREX METHOD. Baehr, W; Dippel, Th. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Heisse Chemie). Translation of report KFK-673. 20p. (EUR-3704). Dep. CFSTI.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 25460.

42811 (HMI-B-69) STUDIES ON THE APPLICATION OF TITANIUM COMPOUNDS IN NUCLEAR TECHNOLOGY. Blossfeld, E.; Levi, H. W.; Schiewer, E. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). July 1968. 37p. (In German). Dep.

The production of $SrTiO_3$ from aqueous solutions and the coprecipitation of radioactive ions by $TiO_2 \cdot aq$ were studied. $TiO_2 \cdot aq$ was obtained by the hydrolysis of $TiCl_4$, titanic acid ester, or $K_2TiO(C_2O_4)_2$. A method for the decontamination of radioactive effluents is described. A $SrTiO_3-TiO_2$ mixture was obtained by ion exchange of $K_2Ti_2O_5$ with Sr ions, whereas the reaction of tetraisopropyl titanate with aqueous solutions of Sr salts at high pH values and temperatures above 65°C results in the formation of pure $SrTiO_3$. (auth)

42812 (GAMD-8458) COST OF REPROCESSING HTGR FUELS IN CENTRAL PLANTS OF VARIOUS CAPACITIES. Shefcik, J. J. (Gulf General Atomic, Inc., San Diego, Calif.). Dec. 29, 1967. Contract AT(04-3)-167. 28p. Dep. CFSTI.

Based on the conceptual design and the costs developed for the recovery of thorium and uranium from spent HTGR fuel elements in a central reprocessing plant sized to serve a 15,000 MW(e) HTGR economy, costs were derived for two other HTGR fuel reprocessing plants of different capacities. These two other central reprocessing plants are sized to serve HTGR economies of 5,000 and 45,000 MW(e). The HTGR fuel considered is a hexagonal block element containing pyrolytic-carbon-coated fertile particles and silicon carbide-coated fissile particles. Flowsheets are based on a burn-leach head-end process, which prepares the HTGR fuel elements for subsequent decontamination and separation of the bred uranium. The estimated capital, operating, and reprocessing costs are given. (M.C.G.)

42813 (K-L-1780(Pt.26)) ORGDP FUEL REPROCESSING STUDIES. Progress Report for Period Ending April 20, 1968. Pashley, J. H. (Oak Ridge Gaseous Diffusion Plant, Tenn.). July 1, 1968. Contract W-7405-eng-26. 32p. Dep. CFSTI.

Three semiwork runs were performed. In the first, decladding and oxidation were carried out with a normal assay PRTR test fuel element. Pellet oxidation of normal assay solid cylindrical pellets was undertaken in the second run. Semicontinuous pellet charging was accomplished during oxidation in the third test with annular EGCR pellets. Long-term durability testing of the peripheral compressor was continued. The peripheral compressor was disassembled for bearing replacement, and was inspected for corrosion and wear. Studies of the absorption of uranium hexafluoride in low concentrations by sodium fluoride were made. Stainless steel filters were tested in multicycle service with reactor off-gases from the decladding and oxidation operations. Scoping calculations for volatility reprocessing of spent Fast Breeder Reactor fuels were made in three general areas. These are: alumina usage economics, transfer of radioactive heat from fluid-bed reactors, and plutonium fluorination requirements. (J.G.B.)

42814 (K-L-6198) CONCENTRATION AND COLLECTION OF KRYPTON AND XENON BY SELECTIVE ABSORPTION IN FLUOROCARBON SOLVENTS. Merriman, J. R.; Pashley, J. H.; Habiger, K. E.; Stephenson, M. J.; Anderson, L. W. (Oak Ridge Gaseous Diffusion Plant, Tenn.). [1967]. Contract W-7405-eng-26. 14p. (CONF-680811-3). Dep. CFSTI.

From Symposium on Operating and Developmental Experience in the Treatment of Airborne Radioactive Wastes, New York.

Developments in studies on preferential absorption of noble gases in a high-capacity fluorocarbon solvent are discussed. The primary emphasis is on determining scale-up data necessary to design plant systems for a variety of applications, including; the treatment of air within a nuclear reactor containment building in the event of an accidental fission gas release; off-gases from processing plants reclaiming values from irradiated fuel; and gases that blanket the cores of certain types of nuclear reactors. The results of tests on two refrigerants, trichlorofluoromethane and dichlorodifluoromethane, are discussed. (P.C.H.)

42815 (K-Trans-36) ISOTOPIC SEPARATION PROCESS. Robieux, Jean; Auclair, Jean-Michel. Translated for Oak Ridge Gaseous Diffusion Plant, Tenn., from French Patent 1,391,738. 7p. Dep. CFSTI.

A process was developed for isotope separation by selective ionization of a single isotopic component of a gas consisting of a mixture of isotopes. It consists of two operations: irradiation by a narrow band of energy followed by irradiation with another band of energy, each band being of different wavelengths. (M.C.G.)

42816 (UJV-1921) EXTRACTION OF NITRIC ACID, URANIUM, PLUTONIUM, AND FISSION PRODUCTS WITH PHOSPHONATES, PHOSPHINATES, AND PHOSPHINE OXIDES. IV. EXTRACTION OF RUTHENIUM AND SEPARATION OF URANIUM FROM THIS FISSION PRODUCT. Talas, M. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Feb. 1968. 30p. Dep.

The extraction of trace concentrations of nitrosoruthenium(III) nitrates by butyl esters of phosphonic acids of the $(BuO)_2:PO:R$ type (where R = methyl, butyl, isoamyl, and phenyl), phosphinic acids of the $BuO \cdot PO:R_2$ type (where R = methyl, butyl, and isoamyl) and by trialkyl phosphine oxides R_3PO (where R = butyl and hexyl) was investigated. The dependence of the extraction of ruthenium on the concentration of nitric acid, the salting-out agent ($NaNO_3$), and extractant was studied both in the presence and absence of uranyl nitrate, as well as the dependence on the concentration of uranyl nitrate itself. The extraction of ruthenium from acid-deficient solutions of uranyl nitrate was also studied. The results obtained were also utilized for evaluating the efficiency of the separation of uranium from ruthenium. (auth)

42817 (UJV-1924) EXTRACTION OF NITRIC ACID, URANIUM, PLUTONIUM, AND FISSION PRODUCTS WITH PHOSPHONATES, PHOSPHINATES, AND PHOSPHINE OXIDES. V. EXTRACTION OF CERIUM (III) AND SEPARATION OF URANIUM FROM THIS FISSION PRODUCT. Talas, M. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Mar. 1968. 28p. Dep.

Cerium(III) nitrate was extracted by the tested extractants to a less extent than zirconium(IV) and niobium(V) nitrates or nitrate complexes of nitrosoruthenium. Uranyl nitrate present in the solution reduced considerably the extraction of cerium. The order of the extraction efficiency, as far as the singular types of organophosphates are concerned, is similar to that determined when uranyl nitrate, zirconium and niobium nitrates, and nitrosoruthenium complexes are extracted (namely, phosphonates < phosphinates < phosphine oxides). The extraction efficiency of individual organophosphates within the limits of the corresponding group decreased, in most cases, with increasing length of the alkyl bonded to the functional group of phosphoryl. Cerium can be extracted with success mainly at low acidity of the aqueous phase, at sufficient free concentration of the extractant, and in the presence of the salting-out agent. In order to reach an efficient separation of uranium from cerium the competitive extraction between cerium(III) nitrate and nitric acid at higher nitric acid concentration (about 5M), and eventually the saturation of the extractant by uranium may be utilized. The saturation of the organic phase with uranium only, and the application of the salting-out agent, at low acidity of the aqueous phase, led to a lower separation in comparison with the extracting from strong acidic solutions. The dibutyl ester of butylphosphonic acid was the most suitable extractant. (auth)

42818 METHOD FOR ENRICHING URANIUM ISOTOPES BY MEANS OF ION EXCHANGE. (to Japan Atomic Energy Research Inst.). British Patent 1,120,208. July 17, 1968. Priority date July 30, 1964, Japan.

A solution containing ^{235}U or ^{238}U or a mixture of the two can be enriched by contacting the solution containing U in the hexavalent state in countercurrent flow in an exchange column or tower with particles of an acidic cation exchange resin on which tetravalent U has been absorbed. The contacting solution should be 1 N or less in acidity. The process may be carried out in a succession of at least three columns of moving resin. The acidic exchange resin particles are moved from the upper end to the lower end of the column, and the hexavalent U solution is moved toward the upper end of the column against the resin movement. (B.L.M.)

42819 METALLIC ZINC METHOD OF SEPARATING THORIUM FROM RARE EARTH ELEMENTS. Chang, Yuan-hui; Hsiao, Jih-tung; Yuan, Ch'i-hua; Hsiao, When-chin. Wu Han Ta Hsueh Tzu Jan K'o Hsueh Hsueh Pao Hua Hsueh Chuan Hao, No. 2, 59-67(Feb. 1960). (In Chinese).

The method using metallic Zn to separate Th and rare earth elements in solution requires only simple tools. The raw materials are metal and a small quantity of HCl and NH_4OH. The amount of Zn used is about 1.5 to 2.0 times of the amount of ThO_2; therefore, this method is economically reasonable. The rate of return for Th may be above 91%. The Th obtained is in a fibrous shape and contains foreign substances, however. The method of turning the $Th(OH)_4$ into tight sediments and the method of adding a suitable buffer so that the pH may be controlled to 5.0 to 6.0 are subjects for future study. (JPRS)

42820 DISTRIBUTION OF HYDROCHLORIC ACID BETWEEN TRI-n-BUTYL PHOSPHATE AND WATER. Hanson, C.; Patel, A. N. (Univ. of Bradford, Eng.). J. Appl. Chem. (London), 18: 209-12(July 1968).

The distribution of hydrochloric acid between water and 40 vol % solutions of tri-n-butyl phosphate (TBP) in six diluents and also between water and 20, 40, and 60 vol % solutions of TBP in odourless kerosene and pure TBP at 20, 30, and 50°C was studied to find the effects of temperature, diluent, and TBP concentration on the extractability of hydrochloric acid and on third-phase formation. (auth)

42821 STUDIES ON THE REMOVAL OF RADIONUCLIDES IN MILK. PART I. QUALITIES OF MILK TREATED WITH CATION-EXCHANGE RESIN OF THE COMPOSITE SALT FORM. Kondo, Satoru; Saito, Kensuke (Snow Brank Milk Products Co., Ltd., Japan). Nippon Nogeikagaku Kaishi, 42: 72-8(Feb. 1968). (In Japanese).

To remove cationic radionuclides from milk by ion exchange, the optimum ratio of major cation (Ca, Mg, Na, and K) on strong sulfonic acid ion-exchange resin, Amberlite IR-120, was determined so as to keep the change in the cationic composition in the milk as small as possible. The suitable salt composition in the solution, which was used to regenerate the resin, was as follows; Ca 0.67, Mg 0.23, Na 0.13, and K 0.77 equivalent/l of the solution. In order to minimize the change in milk quality at the early stage of the ion-exchange process, 3 to 10 times milk against resin by volume was used. No difference in total solids, fat, protein, lactose, and ash contents between non-treated and the treated milk was observed, though trace amounts of these components were absorbed on the surface of the resin particles. The increases in Ca, Mg, K, and Na contents in the treated milk were −7.5%, +5.7%, +18.4%, and −4.1%, respectively, compared with original milk. Free Ca ion was easily exchanged by the resin. The treated milk, therefore, showed lower curd-tension value and longer rennet coagulation time compared with non-treated milk. Lower curd-tension value was recovered by adding $CaCl_2$. (NSA of Japan)

42822 STUDIES ON THE REMOVAL OF RADIONUCLIDES IN MILK. PART II. FACTORS AFFECTING THE REMOVAL OF RADIOACTIVE STRONTIUM AND CESIUM FROM MILK BY CATION-EXCHANGE RESINS. Koga, Yoshikazu (Tokyo Univ.); Kondo, Satoru. Nippon Nogeikagaku Kaishi, 42: 79-83(Feb. 1968). (In Japanese).

The effect of the pH of the milk, temperature, flow rate, and volume of milk on the removal of radioactive Sr and Cs from milk was studied. The milk was labeled with ^{85}Sr or ^{134}Cs (1 μc/l of milk) in vitro and was passed through a column containing Amberlite IR-120 (Ca : Mg : K : Na) resins. The amount of ^{85}Sr removed from the first 5 resin bed volume (rbv) was increased from 59.1 to 93.7%, as the milk was acidified from pH 6.6 to 5.45, contrasting with ^{134}Cs, which was not increased. When milk was passed through at normal pH (6.65), about 7% more removal for ^{85}Sr was obtained at 30.0°C than at 12.5°C. But no increase was obtained by heating the milk for the removal of ^{124}Cs and ^{85}Sr (pH 5.45). The removal of ^{85}Sr from milk (pH 6.60) decreased from 65.7 to 60.8%, as the flow rate was increased from 0.083 to 0.333 rbv/min. The removal up to 50 rbv at a flow rate of 0.167 rbv/min were 55.9% for ^{85}Sr (at pH 6.60), 88.0% for ^{85}Sr (at pH 5.45), and 45.7% for ^{134}Cs (at pH 6.60). (NSA of Japan)

42823 STUDIES ON THE REMOVAL OF RADIONUCLIDES IN MILK. PART III. THE REMOVAL OF ^{131}I IN MILK. Sakai, Shigeo (Japan Organo Co., Ltd.); Miyahara, Akimitsu. Nippon Nogeikagaku Kaishi, 42: 84-9(Feb. 1968). (In Japanese).

To remove the anionic radionuclide, ^{131}I, from milk by use of an ion-exchange technique, the optimum ratio of major anions (Cl^-, PO_4^{3-}, $C_6H_5O_7^{3-}$) on strong base quaternary ammonium type ion-exchange resin, Amberlite IRA-410, was determined so as to keep the anionic compositions in the milk as small as possible. The suitable salt composition in the solution used to regenerate the resin was as follows: Cl^- 0.09, $C_6H_5O_7^{3-}$ 0.83 and PO_4^{3-} 0.08 equivalent/l of the resin. No difference in total solids, fat, protein, lactose, and ash contents between untreated milk and the treated milk was observed, though trace amounts of these components were adsorbed on the surface of the resin particles. The decreases in chlorine, citrate, and phosphate contents in the treated milk were 8.8%, 1.4%, and 11.6%, respectively. Lower curd-tension value of treated milk compared with non-treated milk by pH increase was recovered by pH adjustment. Iodine removal by the composite salt form resin was above 99% for the 200 times milk against resin. (NSA of Japan)

42824 SEPARATION OF COPPER ISOTOPES BY ELECTROMIGRATION IN A CATION-EXCHANGE MEMBRANE. Kakihana, Hidetake; Kanzaki, Tadao; Okamoto, Makoto; Yokotsuka, Seiichiro; Hoshi, Jyoe (Tokyo Inst. of Tech.). Nippon Kagaku Zasshi, 89: 230-5(Mar. 1968). (In Japanese).

The electric conductivities of cation exchange membranes of various mono- and bivalent cation forms were measured. The order of the mobilities of the cations in the membranes was found $H^+ > K^+ > Na^+ > Li^+ \gg Cu^{2+} > Ca^{2+} > Ni^{2+} > Mg^{2+} > Ba^{2+} \gg UO_2^{2+}$. Based on this result, the electromigration of copper isotopes through the membrane was investigated by two different procedures: A 2 cm of copper zone, inserted between two lithium zones, was moved through the cation exchange membrane under 12 to 24 volts per centimeter. After 5.5, 50, and 100 hr migrations, the copper zones diffused broadly to the rear, and for each case a maximum of isotopic ratio($^{65}Cu/^{63}Cu$) was observed: both in the front and in the rear parts of the zone ^{63}Cu was enriched and in the middle part ^{65}Cu was enriched. From the anode compartment filled with 0.5 mole/l $CuSO_4$ aqueous solution the copper ion was introduced to the cation exchange membrane of H^+-form by passing an electric current until a 2 cm copper zone was formed. Replacing the anode solution with 0.1 mole/l $CaCl_2$ aqueous solution, the copper zone was followed by a calcium zone. In this case, after 10 hr migration under 5 to 25 volts per centimeter the copper zone migrated without any appreciable diffusion. The enrichment of ^{65}Cu at the rear part of the copper zone was observed as clearly as the enrichment of ^{63}Cu at the front. Starting from the natural isotopic ratio(^{65}Cu/^{63}Cu) 0.445, the isotopic ratio changed to 0.436 or 0.439 at the front and to 0.452 or 0.451 at the rear. From these results, the relative difference(ϵ) between average migration velocities of two isotopic ions was estimated as 0.00012 to 0.00017. This value of the copper isotopes was much lower than the value obtained for lithium isotopes which had been reasonably explained by the square root mass effect of hydrated ions. (auth)

42825 LIQUID-LIQUID EXTRACTION OF THE RARE EARTHS. Weaver, Boyd (Oak Ridge National Lab., Tenn.). Progr. Sci. Technol. Rare Earths, 3: 129(1968).

Liquid-liquid extraction of rare earths has become an industrial and commercial operation. Applications were first to the recovery and purification of nuclear-fission products, then to the separation of a continually increasing number of natural rare earths, and finally to the isolation of the newest elements, the transplutonide homologues of the lanthanides. This review of progress over the last 5 or 6 years is an attempt to provide a co-ordinated guide to the literature, while presenting some of the more important facts in some detail. The treatment is divided according to classes of extractants and a few special topics. (auth) (UK)

42826 ELECTROPHORETIC SEPARATION OF CARRIER-FREE RADIONUCLIDES. Buchtela, K.; Aitzetmueller, K.; Grass, F. (Atominstitut der Oesterreichischen Hochschulen, Vienna). J. Radioanal. Chem., 1: 225-30(May 1968).

The electrophoretic separation of radioactive rare earths on Cellogel in α-hydroxyisobutyric acid is described. Minute amounts of radioactive daughter nuclides are separated from the neutron-irradiated rare earth target materials, the ratio of the substances being $10^5 : 1$ to $10^7 : 1$. The suggested method is simple, rapid, and suitable for analytical purposes. (auth)

42827 SORPTION AND FIXATION OF ^{137}Cs BY SERICITE. Matsumura, Takashi (Radiation Center of Osaka Prefecture). Radioisotopes (Tokyo), 17: 363-7(Aug. 1968). (In Japanese).

Sericite, which is one of 2 : 1 layer lattice clays with unexpanded 10 Å c-spacing, was found to be effective for removal of ^{137}Cs from waste solution. About 95% of the ^{137}Cs is removed by the addition of 500 ppM of Na-form sericite into the waste solution. The removals are satisfactorily high at the pH range between 3 and 10 and decrease abruptly at a pH lower than 2. The removal is not influenced by the presence of about 1,000 ppM of competing Na or Ca ion concentration; however, it is remarkably decreased by the presence of competing K or Cs ions. ^{137}Cs is "fixed" in the lattice structure of sericite and is not entirely desorbed by the different leaching solutions. However, about 20% of the "fixed" ^{137}Cs is desorbed by primary amine solutions. This behavior suggests that about 80% of the sorbed ^{137}Cs enters at the interlayer and 20% at the interlattice edge or the external planner edge of sericite. (auth)

42828 RECOVERY OF PROTACTINIUM FROM MOLTEN FLUORIDE SALTS. Grimes, W. R.; Shaffer, J. H. (to United States Atomic Energy Commission). U. S. Patent 3,395,991. Aug. 6, 1968.

A reprocessing method for recovering protactinium from molten metallic fluoride salts is described. The method comprises adding a minor quantity of thorium metal to the salt to reduce the protactinium values to metal and thereafter contacting the salt with finely divided iron to sorb the protactinium metal thereon. (AEC)

42829 RADIOCHEMICAL ISOLATIONS. V. ISOLATION OF LANTHANIUM, BARIUM, CAESIUM, AND TELLURIUM FROM THE PRODUCTS OF CERIUM SPALLATION. Mastalka, A.; Chalkin, V. A.; Lebedev, N. A. (Inst. of Nuclear Research, Rez, Czech. Joint Inst. of Nuclear Research, Dubna, USSR). Collect. Czech. Chem. Commun., 33: 2332-6(July 1968).

The neutron-deficient nuclei of lanthanum, barium, cesium, tellurium, and other elements may be obtained by spallation of cerium by protons accelerated to high energies (680 MeV). It is necessary to separate the mixture of isotopes obtained during this nuclear reaction. It was necessary to combine the methods used for isolating individual elements and modify them to suit the experimental conditions. After separating cerium by a method described previously, ammonium phosphotungstate was used for isolating the cesium, ion exchange chromatography for separating the lanthanides and barium, and reduction by SO_2 for the isolation of tellurium. (auth)

42830 ION-EXCHANGE-RESIN SYSTEM FAILURES IN PROCESSING ACTINIDES. Miles, F. W. (Oak Ridge National Lab., Tenn.). Nucl. Safety, 9: 394-406(Sept.-Oct. 1968).

Seven instances of ion-exchange-resin system failures have been reported in nuclear work since June 26, 1962, and five studies have been made of the thermal stability of nitrate-form resins. All instances apparently involved the self-ignition of nitrate-form resins (with both aromatic and aliphatic matrices) in strong (>7$\underline{N}$) nitric acid in the presence of some amount of heat. In one of the studies, a chemical mechanism was postulated whereby an uncontrollable reaction can occur with the nitrate-form anion resin in strong HNO_3 solutions. Two groups of precautionary measures are suggested: those associated with the chemistry of resins, such as maximum operating temperature and ionic loading limits, and those common to chemical processing, such as pressure-relief devices and adequate rules concerning procedural changes. (auth)

42831 IMPROVEMENT IN ENRICHMENT PROCEDURE FOR ANALYSIS OF TRITIUM IN NATURAL WATER. Takahashi, Tan; Hamada, Tatsuji; Ohno, Shigeru (Inst. of Physical and Chemical Research, Tokyo). Radioisotopes (Tokyo), 17: 357-62(Aug. 1968).

In the electrolytic enrichment of tritium in water, the relationship between the separation factor of deuterium (α) and that of tritium (β) was reexamined using electrodes made of various materials. By use of the nickel-nickel electrode unit and a small glass cell incorporating up to 100 ml of water, a good constancy of β was obtained for the volume reduction ratio ranging from $^1/_{12}$ to $^1/_{23}$, which enables the enrichment factor to be determined with an accuracy of ±6% dispensing with the deuterium analysis. With the large metallic cell for an initial sample volume of up to 1 liter, the relationship between α and β was found to be well approximated by Östlund's formula with an accuracy of ±10%. (auth)

42832 ION EXCHANGE IN MOLTEN SALTS. I. THE ION-EXCHANGE PROPERTIES OF SODIUM ZEOLITE A IN MOLTEN $NaNO_3$; EXCHANGE REACTIONS WITH ALKALI METAL, THALLIUM, AND SILVER CATIONS. Liquornik, M.; Marcus, Y. (Israel Atomic Energy Commission, Yavne). J. Phys. Chem., 72: 2885-9(Aug. 1968).

Cation-exchange equilibria between sodium zeolite A and molten mixtures of sodium nitrate and those of lithium, potassium, cesium, silver, or thallium were studied over substantial ranges of compositions of the exchanger at 330°C (350°C for the potassium exchanges). In those cases (lithium, sodium, silver) where occlusion of nitrate in the α cage of the zeolite occurs, all of the cations can be exchanged, but in the other cases limited exchange only occurs. When extrapolated to trace concentrations in the sodium zeolite–sodium nitrate system, the selectivity order is $Cs > Tl > Ag > K > Li > Na$, but the positions of Cs, Tl, and K are transposed to the rights as their loading increases. The standard free energy change for complete exchange from sodium to silver zeolite in equilibrium with the pure molten salts at 330°C is $\Delta G° = -3230$ cal/mol. (auth)

42833 SOLVENT EXTRACTION OF NIOBIUM AND TANTALUM. IV. EXTRACTION SPECIES WITH DI-n-OCTYL-METHYLENE-BIS-PHOSPHONIC ACID. Djordjevic, C.; Gorican, H.; Tan, S. L. (Univ. of Zagreb. Inst. Rudjer Boskovic, Zagreb). J. Inorg. Nucl. Chem., 29: 1505-9(June 1967).

The extracting species formed by niobium and tantalum with di-n-octyl-methylene-bisphosphonic acid were separated from the organic phase and characterized by analysis and ir spectra. A previously proposed extraction mechanism for these metals from oxalic and hydrofluoric solutions was confirmed. Molecular weight studies showed that the organophosphonic metal derivatives steadily polymerize in the organic phase. The niobium and tantalum polymers are not of the same type. (auth) (UK)

42834 RECOVERY OF RADIOACTIVE CESIUM ON TITANIUM PHOSPHATE. Beaudet, C.; Cremer, J. (SERAI, Brussels). Nucl. Appl., 5: 64-7(Aug. 1968).

The recovery of cesium from simulated nuclear wastes was performed by adsorption on titanium phosphate and elution either with ammonium nitrate or ammonium chloride. The reproducibility of synthesis of the ion exchanger on pilot-plant scale was excellent, and a sufficient number of cycles (adsorption-elution), at least eight, can be achieved without any decrease in performance. (auth)

42835 SEPARATION OF URANIUM AND RARE EARTH METALS ON SULPHONIC CATION EXCHANGER KU-2. APPLICATION OF PRECIPITATING REAGENTS. Krawczyk-Obojska, I. (Inst. Nuclear Research, Warsaw). Chem. Anal. (Warsaw), 12: 13-21(1967). (In Polish).

Experiments indicate that, when retained on the H^+ form of this cation exchanger, U(VI) may be separated from La, Ce, Eu, Gd, Ho, and Y with a $1\underline{N}$ solution of oxalic acid or of sodium, potassium, or ammonium fluoride. The subsequent recovery of these elements is obtained with $5\underline{N}$ HCl. Scandium, which forms strong complexes with both oxalic acid and fluorides, emerges with U(VI). (Anal. Abstr.)

42836 EXPERIMENTAL STUDY OF THE HYDROMETALLURGIC CONCENTRATION OF THORIUM MINERALS BY LIQUID-LIQUID EXTRACTION IN SULFURIC ACID MEDIUM: APPLICATION IN THE TREATMENT OF MONAZITE BY THENOYLTRIFLUOROACETONE IN A PULSED COLUMN. **Collee, R. Chim. Ind., Genie Chim., 98: 719-33(Oct. 1967). (In French).**

Various methods developed for purification of Th for use as nuclear fuel are discussed, and an experimental study reported on the concentration of Th ore by liquid-liquid extraction in H_2SO_4 medium. Studies were done on the concentration as well as the metallurgic assay of Th ores. Concentration of monazites was also observed by liquid-liquid extraction in the H_2SO_4 medium. Results showed the importance of thenoyltrifluoroacetone (TTA) and other chelating complexes in effecting the separation of Th from Ce by extracting the H_2SO_4 solutions. The concentration of Th ores was described, employing various types of apparatus, especially a pulsating pilot column. By this method the amount of residual Ce was very small, less than 1%, with the result that the Th-bearing solutions were markedly purified in Ce and thus were well suited for further operations leading to the elaboration of fuel-grade Th. The economic aspects of extraction of Th from the ores for use as nuclear fuel are discussed. (BBB)

42837 SOLUTIONS OF URANYL SALTS IN BUTYL PHOSPHATES. **Brusset, Henry; Coulon, Alain (Faculte des Sciences, Paris). Chim. Ind., Genie Chim., 98: 734-42(Oct. 1967). (In French).**

Selective liquid-liquid extraction of uranyl nitrate in acidic aqueous solution by a solution of tributyl phosphate in an organic fluid, is considered as an important stage in production of uranyl nitrate, prior to the elaboration of metallic U. A spectroscopic study was made in the intermediate infrared range and an interaction was observed between the phosphoryl group (P=0) of trialkyl phosphates and the U atom when the uranyl salt was dissolved in the organic phase. These observations confirmed and enlarged earlier studies, which are reviewed. Mixed uranyl and butyl phosphates in the solid state were prepared and analyzed. Tributyl phosphate and dibutyl phosphate mixtures were studied, and the molecular interactions between those 2 compounds occurring before introduction of uranyl salts were considered. The different extraction behavior of uranyl nitrate and uranyl chloride was emphasized. (BBB)

42838 CONTRIBUTION TO THE STUDY OF COLUMN FRACTIONATION FOR ISOTOPE SEPARATION BY CHEMICAL EXCHANGE. **Mahenc, J.; Pompidor, G. (Faculte des Sciences, Toulouse). Chim. Ind. (Paris), 99: 1137-47(Apr. 1968). (In French).**

A comparison was made of the efficiency of the different zones of an isotope-enriching column used for the separation of ^{15}N. The exchange of ^{15}N occurred between 2 countercurrent flowing phases of aqueous HNO_3 and gaseous NO_3. It was shown that the initial transient period can be divided in 2 parts. It was possible to establish a correlation between these periods and the 2 parts of the column at the steady state. During the second transient period a mathematical relation was found to be applicable for curves plotted for the variation of composition of ^{15}N against time at different levels of the column. A method for comparing the efficiency of operation at different levels of the separation column is proposed. The method requires knowledge of the transient period before the steady state is reached when column is working under total reflux. The efficiency of the upper part of the zone where the oxidation-reduction effect is important between the 2 phases is emphasized. (BBB)

42839 ON THE MECHANISM OF EXTRACTION OF URANIUM AND THORIUM BY MONOCARBOXYLIC ACIDS. **Borbat, V. F.; Merkin, E. N.; Ivanovskii, M. D. Kolloid Zh., 30: 10-12(Jan.-Feb. 1968). (In Russian).**

Surface tension and conductivity studies measurements indicate the existence of critical concentrations for micelle formation in aqueous solutions of U and Th soaps. Soap formation processes are included in a discussion of the mechanism of extraction of U and Th by fatty acids. A soap formed from hydroxides of the metals and a fraction of C_7 to C_9 fatty acids melting at 236 to 240°C was used. Critical soap concentrations were measured by surface tension at 25°C and found to be 13.4 mg/l for the uranyl soap and 0.42 mg/l for the Th soap. By conductivity, the critical concentrations were found to be 16.0 mg/l for the uranyl soap and 0.79 mg/l for the Th soap. Stages of the process of extraction are suggested to include micelle formation of soaps and are compared with the mechanism for extraction of heavy metals by amines. (BBB)

42840 PROCESS FOR THE REMOVAL OF HYDROGEN AND/OR OXYGEN FROM GASEOUS MIXTURES. **(to Engelhard Minerals and Chemicals Corp.). British Patent 1,123,585. Aug. 14, 1968. Priority date Sept. 3, 1964, United States.**

A process is described for the removal of H_2 and/or O_2 from a gaseous mixture by catalytic combination with stoichiometric quantities of O_2 and/or H_2 in the presence of a catalytically inert unitary essentially crystalline refractory structure having a bulk density of from 0.45 to 1.05 g/cm^3 and having a number of gas-flow channels extending through it. The catalyst structure is made up of an activated refractory oxide on which Pt, Pd, Rh, or Ru or an alloy or mixture of two of these has been deposited. The process is also applicable to the removal of D_2. (B.L.M.)

42841 IMPROVEMENTS IN COLUMNS FOR ISOTOPE SEPARATION BY CHROMATOGRAPHY. **Botter, Fernande; Dirian, Gregoire; Menes, Janine; Tistchenko, Serge (to Commissariat a l'Energie Atomique). British Patent 1,123,044. Aug. 7, 1968. Priority date Aug. 28, 1964, France.**

A column for the separation of H isotopes consists of a tube provided with gas inlets and outlets, means for heating and cooling the tube, and granular solid sintered porous material for filling the column. The porous material absorbs substantially no water, the mean diameter of the pores is from 1 to 200 μ, and Pd is deposited as sponge on the pores of the material. The filling of Pd-bearing granules may be preceded upstream by a filling of granules of a dessicant, from which it is separated by a metal gauze. The input and output of gas are placed respectively on the upper and lower part of the column to create a descending flow. (B.L.M.)

42842 ENRICHMENT OF LITHIUM, POTASSIUM, COPPER, AND URANIUM ISOTOPES BY ELECTROMIGRATION IN A CATION EXCHANGE MEMBRANE. **Kakihana, H.; Okamoto, M.; Fujii, Y. (Tokyo Inst. of Tech.). Isotopenpraxis, 4: 232-4(June 1968).**

An apparatus used is shown. From the anode solution the cationic isotopic ions move into the cation exchange membrane on application of suitable voltage between the anode and cathode. Experimental conditions are described for Li, K, Cu, and U isotopes. (M.C.G.)

42843 SEPARATION OF THE ISOTOPIC MOLECULES OF HYDROGEN ON THE H-FORM OF SYNTHETIC ZEOLITES. **Gryaznova, Z. V.; Nikitin, O. T.; Tsitsishvili, G. V.; Bezhashvili, K. A. (Moscow State Univ. Inst. of Chemistry, Tbilisi, USSR). Isotopenpraxis, 4: 226-7(June 1968). (In Russian).**

The separation of isotopic molecules of hydrogen on the H-forms of zeolites of A, X, Y types, and mordenite is described. The H-D exchange with the hydrogen ions of the zeolites studied was also investigated. It is shown that the separation factor $\alpha HD/H_2$ for the H-forms of the zeolites increases with the increase of the silica to alumina ratio, i.e., from A type zeolite to mordenite, while this dependence is vice versa for the initial Na-form of the same zeolites. The A and X type zeolites as well as mordenite show a noticeable H-D exchange. Taking into account that the H-form may be decationized during the regeneration of the zeolites, the separation of the hydrogen isotopes is studied for the decationized zeolites. (auth)

42844 Na, K, Mg, AND Ca SALTS INFLUENCE ON EXTRACTION OF Ce AND Y INTO HDEHP FROM ACID SOLUTION. **Moskvin, L. N.; Portnyagin, V. I. At. Energ. (USSR), 24: 568-70(June 1968). (In Russian).**

Coefficients of Ce and Y distribution during extraction by D2EHPA (bis-(2-ethylhexyl)ester of phosphoric acid) from hydrochloric acid solutions containing Na^+, K^+, Mg^+, and Ca^+ ions were determined. Data obtained showed that the influence of the impurities on Ce distribution decreased in the order Ca > Mg > K > Na; an identical effect was observed with Ca and Mg in Y distribution. An increase of aqueous phase acidity weakened the influence of the impurity ions. An increase of impurities in the aqueous solution reduced the effects of D2EHPA concentration in the organic phase on the magnitude of the coefficients of distribution. (R.V.J.)

42845 MATHEMATICAL MODEL OF THE EXTRACTION OF ZIRCONIUM AND HAFNIUM WITH ALCOHOLS. **Granovskii, Yu. V.; Komissarova, L. N.; Smirnova, N. S.; Chernova, N. A.; Spitsyn, V. I. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol., 11: 546-50(1968). (In Russian).**

A mathematical model for the separation factor of Zr and Hf during extraction with octyl alcohol from hydrochloric acid solution was derived. The factors investigated with respect to their influence on the separation effect can be represented in the following series: acid concentration ≫ metal concentration > alcohol concentration > phase ratio. The determining value for the separation effect is the acid concentration; its effect does not depend on the conditions in which the other factors occur. It was found that the interactions of the metal concentration—phase ratio and alcohol concentration—phase ratio do not appear very significant. (tr-auth)

42846 SEPARATION OF RARE EARTH ELEMENTS WITH TRILON B IN ACID MEDIUM. Khramov, V. P.; Aliev, G. A. (Saratov Inst. of Mechanization of Rural Economy, USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol., 11: 516-19(1968). (In Russian).

The separation of the total rare earth elements of the first group was done on cationite KU-2 using as elution agent a 0.5% solution of Trilon B in citrate, biphthalate, glycocoll (glycine), and succinate buffer at pH 3.0. The greatest separation was observed in the case of citrate and glycocoll buffer. It was established spectrophotometrically that the introduction of citrate buffer in eluant solution of Trilon B increases the discrimination in the complex formation with Nd and Pr, which makes it possible to obtain a very good separation. (tr-auth)

EARTH SCIENCES

Geology and Hydrology

Refer also to abstracts 42922, 42975, 43129, 43134–43136, 43139, and 43311.

42847 (IS-T-217) ABSOLUTE ABUNDANCE OF THE TITANIUM ISOTOPES IN NATURE. Belsheim, Harold Arthur (Ames Lab., Iowa). May 1968. Contract W-7405-eng-82. 91p. Dep. CFSTI.

Thesis.

Abundances in 20 titanium ores and minerals of worldwide occurrence and in the TiO_2 used in the chemical determination of the atomic weight of titanium were compared with the abundances in a reference sample of TiO_2. No variations were found. This means that unknown sample ratios divided by reference sample ratios (ratios with respect to ^{48}Ti and measured on the same day) are 1.0000 ± the following standard deviations: ^{46}Ti – 0.0048; ^{47}Ti – 0.0030; ^{49}Ti – 0.0030; and, ^{50}Ti – 0.0051. The mass spectrometer was calibrated by analyzing mixtures of separated titanium isotopes. From the calibration were obtained the absolute abundances in the reference sample, and thereby also the absolute abundances in nature. The latter values in atomic per cent are: $^{46}Ti = 8.24 \pm 0.45$; $^{47}Ti = 7.44 \pm 0.22$; $^{48}Ti = 73.71 \pm 0.48$; $^{49}Ti = 5.43 \pm 0.16$; and, $^{50}Ti = 5.18 \pm 0.31$. The calibration gave the preponderant contribution to the error. (auth)

42848 (NP-17492) RADIOACTIVITY SURVEY DATA IN JAPAN, NUMBER 16. (National Inst. of Radiological Sciences, Chiba (Japan)). Aug. 1967. 64p. Dep.

A summary of the radioactivity detected in various media in Japan is given for the period covering the six nuclear tests in The People's Republic of China. Maps of the meteorological trajectories are given. Tables and graphs represent the resulting beta-radioactivity in rain and dusts at the nuclear testing periods in China. (J.C.W.)

42849 (ORO-490-16) RADIOACTIVITY TRANSPORT IN WATER: EFFECTS OF ORGANIC POLLUTION ON RADIONUCLIDE TRANSPORT. Futagawa, Kazuhiro; Gloyna, Earnest F. (Texas Univ., Austin. Environmental Health Engineering Research Lab.). May 1968. Contract AT(11-1)-490. 62p. (EHE-04-6803; CRWR-27). Dep. CFSTI.

The ecological environment of a river system was simulated with the aid of a specially adapted research flume. The characteristics of the spacial and temporal variation of the oxygen concentration in the flume water were determined. The reaeration rate constants, the biological oxidation rate constant, and the photosynthesis and respiration rate of benthal algae were measured. In the determination of reaeration rate constants, the oxygen concentration of the influent was maintained at a constant level by the use of sodium sulfite. Cane sugar was used as a pollutant. The effects of benthal algae on the system were determined under stagnant flow conditions. (auth)

42850 CESIUM AND RUBIDIUM FIXATION IN VERMICULITE AND HYDROBIOTITE. Kaddah, Malek T. (Univ. of California, Riverside). Soil Sci., 106: 67-72(July 1968).

Hydrobiotites (interstratified vermiculite mica) from Libby, Montana and Palabora, South Africa were transformed to vermiculites and the 2 to 10 μ size fractions of the minerals were saturated with tagged Cs or Rb and leached with successive increments of normal chloride solutions of Cs, Rb, NH_4, K, Na and Ca. The samples were radioassayed after each leaching to determine the rate of release of adsorbed Cs or Rb. In another experiment Ca-saturated hydrobiotites and vermiculites were equilibrated with binary chloride mixtures of lattice contracting cations Cs, Rb, NH_4, and K, and the distribution of exchanging cations in the solution and solid phases were determined. The results showed that the displacement of adsorbed Cs and Rb by the normal chlorides of lattice contracting cations was in the order of (1) $K > NH_4 > Rb > Cs$ for adsorbed Cs in hydrobiotites and vermiculites, and for adsorbed Rb in hydrobiotites, and (2) $K \geq NH_4 \geq Rb \geq Cs$ for adsorbed Rb in vermiculites; in hydrobiotites and vermiculites, the lattice expanding Na ions were less effective than K ions in displacing adsorbed Cs and the order of effectiveness was reversed in the case of displacement of adsorbed Rb; relatively more Cs or Rb was displaced by every displaceing cation from hydrobiotites than from vermiculites and from Libby minerals than the corresponding South African minerals; normal NaCl solutions were more effective in releasing Cs or Rb than N $CaCl_2$ solutions; and adsorption of cations by vermiculites and hydrobiotites from binary mixtures of the salts CsCl, RbCl, NH_4Cl and KCl showed that the strength of attachment of the cations to the minerals is in the order of $Cs > Rb > NH_4 > K$. (auth)

42851 PARTITION OF URANIUM AND THORIUM BETWEEN AUGITE AND HOST LAVAS. Nagasawa, Hiroshi (Gakushuin Univ., Tokyo); Wakita, Hiroshi. Geochim. Cosmochim. Acta, 32: 917-21(Aug. 1968).

Contents of U and Th in mineral fractions separated from some volcanic lavas and a peridotite nodule were measured. Th/U ratios were larger in the groundmass than in the augite phenocryst of the lava. In the peridotite nodule, U and Th were most enriched in diopside. Ionic substitution of Ca in clinopyroxene by U and Th under equilibrium conditions is proposed for the possible partition mechanism. (auth) (UK).

42852 DIFFUSION COEFFICIENTS AND THE MEAN FREE PATHS OF THE NEUTRAL AND CHARGED RADON DECAY PRODUCTS IN AIR. Porstendoerfer, J. (Justus Liebig-Univ., Giessen, Ger.). Z. Phys., 213: 384-96(1968). (In German).

The diffusion coefficients of radioactive atoms and ions in air are very important in a number of investigations on and computations of the attachment of radon decay products to aerosol particles. Measurements of the diffusion coefficients of neutral and charged ^{212}Pb atoms are reported. The values found are: $D_0 = (7.6 \pm 0.4) \times 10^{-2}$ cm^2 s^{-1} for neutral atoms, and $D = (5.0 \pm 0.3) \times 10^{-2}$ cm^2 s^{-1} for charged atoms. The method of measurement allowed the determination of these constants 1 to 5 seconds after the formation of aged ^{212}Pb atoms, so that a "cluster" formation was improbable. The mean free path for neutral ($\lambda_0 = (4.9 \pm 0.3) \times 10^{-6}$ cm) and charged ($\lambda = (3.2 \pm 0.2) \times 10^{-6}$ cm) ^{212}Pb atoms in air were computed from the measured diffusion coefficients. All results were compared with values calculated from theory. (auth)

42853 FISSION TRACK AGES OF MICA MINERALS. Miller, D. K.; Bagley, M.; Rao, M. N. (Univ. of Arkansas, Fayetteville). Z. Naturforsch., 23a: 1093-4(July 1968).

The ages of several micas, obtained by the fission track method, and the estimated ages of the regions from which the samples were collected are given. The details of the etching conditions and sample thicknesses are also given. It was concluded that in case of relatively young biotite ($T \approx 10^8$ yr) from Magnet Cove, Arkansas the fission track ages agreed very well with the K–Ar ages, whereas in the case of relatively old ($T \approx 10^9$ yr) micas—biotite from Bancroft, Ontario and lepidomalane from Faraday Township, Ontario, the fission track ages are comparatively lower than the K–Ar ages estimated for these regions. (R.C.K.)

42854 FISSION TRACK AGES OF SOME ALPINE MICAS. Miller, Donald S.; Jaeger, Emilie (Univ. of Bern). Earth Planet. Sci. Lett., 4: 375-8(July 1968).

Fission track ages have been made on 16 micas from the Alps. Previously determined Rb–Sr ages and some K–Ar ages on the same micas gave values ranging from about 20 million yr. to 365 million yr. The fission track ages on all the micas gave a range of 4 to 28 million yr. even though the uranium concentration varied by almost 200 times. Consequently it is proposed that the fission track ages on Alpine micas indicate a time during the cooling history of this metamorphic region at which the temperature was low enough so that the tracks were no longer annealed. (auth)

42855 FISSION TRACK AGES ON 250 AND 2500 M.Y. MICAS. Miller, Donald S. (Rensselaer Polytechnic Inst., Troy, N. Y. Univ. of Bern). Earth Planet. Sci. Lett., 4: 379-83(July 1968).

Anomalous fission track ages were obtained on micas which had been previously dated by the Rb–Sr and/or K–Ar methods. The fission track data for the Middletown, Connecticut pegmatite swarm (255 million yr) ranges from 25 to 1720 million yr. The mica samples from the old continental basement of the United States (2500 million yr) gave ages ranging from less than 1 to 500 million yr. The assumption which is most likely being violated is the "closed system." The loss of daughter product (i.e., fossil fission tracks) and/or the loss or gain of parent (^{238}U) seem to be quite possible. Further studies are required to elucidate the exact cause of the anomalous data. (auth)

42856 FISSION TRACK DATING OF APATITES. Wagner, G. A. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Earth Planet. Sci. Lett., 4: 411-15(July 1968).

Fission track dating was applied to a large number of apatites for the first time. In apatite it is easy to identify fission tracks on the (0001) face if one uses the oil immersion technique. Fission tracks in apatite survive 1 million yr only if the temperature does not exceed 100°C. Apatites taken from different types of rocks from the Odenwald (Germany) were studied. The fission track ages obtained have to be interpreted individually. The apatites taken from volcanic rocks yield crystallization ages. In contrast, apatite ages obtained on basement rocks (granites, granodiorites, gabbros) are related to the uplift history of the Odenwald. (auth)

42857 LEAD ISOTOPES AND THE ORIGIN OF GRANULITE AND ECLOGITE INCLUSIONS IN DEEP-SEATED PIPES. Lovering, J. F. (Australian National Univ., Canberra); Tatsumoto, M. Earth Planet. Sci. Lett., 4: 350-6(July 1968).

The isotopic composition of lead and the concentrations of lead, uranium, and thorium in Delegate basic pipes from Australia and in South African kimberlite pipes were determined. The observed $^{238}U/^{204}Pb$ and observed $^{232}Th/^{238}U$ of eclogite inclusions in the pipes range from 2.9 to 18.7 and from 3.5 to 5.9, respectively. This result as well as the isotopic composition of lead suggests that the upper mantle is chemically heterogeneous with regard to the trace elements. Pyrochemically extracted leads from eclogite inclusions in the Delegate basic pipes and in a South African kimberlite pipe appear to be different in isotopic compositions from leads extracted from the host rock (matrix). These data are consistent with the hypothesis that the eclogitic inclusions in deep-seated pipes are of "accidental" origin and represent upper mantle materials caught up in the host materials during their intrusion. Lead extracted from a two-pyroxene granulite inclusion in one of the Delegate pipes has an isotopic composition indistinguishable from lead in the host rock. This observation is consistent either with a "cognate" origin for the granulite inclusion or with a modified "accidental" origin in which the isotopic composition of the original lead in the inclusion has been contaminated by lead from the host magma. Other evidence would indicate that an "accidental" origin be preferred. (auth)

42858 POSSIBILITIES OF GAMMA-RAY LOGGING IN THE DRIENOK DEPOSIT AT BANSKA BYSTRICA. Simon, Liboslav (Mining Research Inst., Prague). Jad. Energ., 14: 189-90 (May 1968). (In Czech).

The gamma-gamma logging method developed in the Mining Research Institute of the Czechoslovak Academy of Sciences was used in the lead deposit Drienok at Banská Bystrica. With the use of Czechoslovak gamma-gamma logging assembly of the HOÚ 22Š type, the three horizontal narrow drilling holes leading directly from the mine were measured in detail using ^{75}Se and ^{60}Co. The logging curves indicated the position of mineralization, the position of tectonic faults, and the position of the change of the diameter of drilling holes to a lower value. The test results proved the possibility of introducing the given method into the operation at the Drienok lead deposit and at all deposits of similar type. (auth)

42859 RADON AND WATER IN VOLCANIC GAS AT SURTSEY, ICELAND. Bjoernsson, Sveinbjoern (National Energy Authority, Reykjavik). Geochim. Cosmochim. Acta, 32: 815-21(Aug. 1968).

The radon concentration in volcanic gas at the oceanic volcano Surtsey, off the southern coast of Iceland, was found to range from 120 to 170 pC/l of noncondensing gases. The release of gas from ascending magma is briefly discussed and the suggestion made that radon could be used as a tracer for calculating the amount of water released from the erupted magma. For this purpose, information on the distribution coefficient between magma and vapor bubbles for radon is required. From the present data it may only be concluded that the basaltic magma erupted at Surtsey contained less than 0.75 wt % of dissolved water. (auth) (UK)

42860 CONTRIBUTIONS TO THE DISTRIBUTION OF RADIOACTIVE ELEMENTS IN THE CRYSTALLINE FORMATIONS OF THE EASTERN CARPATHIANS. Ianovici, V.; Pitulea, G.; Lemne, M. Stud. Cercet. Geol., Geofiz., Geogr., Ser. Geofiz., 12: 267-85(1967). (In Rumanian).

The results yielded by radiometric field investigations correlated with laboratory explorations allowed for a parallel to be drawn between the U contents in the analyzed samples and their petrography. Thus, a higher U content in acid metaeruptive rocks as against basic metaeruptive rocks and the terrigenic formations could be found. In the latter, higher values were recorded in the mesometamorphic schists as against the epimetamorphic ones. A preferential concentration of U was observed in graphite-containing terrigenic rocks. The laboratory analysis of the samples collected from tectonized and non-tectonized areas emphasized the possibility to detect fracture and crack patterns as well as areas of dynamic retrometamorphism based on the obtained γ-spectra (radioactive unbalance and normal spectra). At the same time, the validity of the data yielded by radiometric field investigations has been ascertained. (auth)

42861 DEUTERIUM CONTENT OF WATER VAPOUR AND HYDROGEN IN VOLCANIC GAS AT SURTSEY, ICELAND. Arnason, Bragi; Sigurgeirsson, Thorbjoern (Univ. of Iceland, Reykjavik). Geochim. Cosmochim. Acta, 32: 807-13(Aug. 1968).

The D/H ratio was measured in the water vapor and hydrogen gas emerging from the oceanic volcano Surtsey. The measurements gave $\delta_D = -55.3\%$ relative to SMOW (Standard Mean Ocean Water) in total hydrogen contained in the volcanic gases. (auth) (UK)

42862 DETERMINATION OF SOIL MOISTURE USING NEUTRON AND GAMMA RAY PROBES. Bibliography No. 1115. Harpenden, Eng., Commonwealth Bureau of Soils, [1968]. 12s.

Sixty-five references are given, covering the period 1963 to 1967. (UK)

42863 ^{90}Sr IN SOIL. Bibliography No. 1034. Harpenden, Eng., Commonwealth Bureau of Soils, [1968]. 14s.

Seventy-five references are given, covering the period 1960 to 1966. (UK)

42864 TRITIUM IN GROUNDWATER AND AS GROUNDWATER TRACER. Bibliography No. 759. Harpenden, Eng., Commonwealth Bureau of Soils, [1968]. 4s.

Twenty-two references are given, covering the period 1956 to 1964. (UK)

42865 EFFECTS OF GAMMA RADIATION ON ACCUMULATION OF MINERAL NITROGEN IN FRESH SOILS. Cawse, P. A. J. Sci. Food Agr., 19: 395-8(July 1968).

Increases in mineral nitrogen in gamma-irradiated soils were investigated in relation to dose over the range 0.05 to 3 Mrad, especially with regard to formation of nitrate. All soils showed a significant increase in nitrate-N after irradiation, but the response was much greater in the most organic series and reached a maximum after 0.4 Mrad; it was followed by a rise in nitrite at 0.6 Mrad. The amount of radiation that gave maximum accumulation of nitrate-N varied between soils, probably owing to differences in the surviving population of nitrifying bacteria. Perfusion of soil with ammonium ions showed that rapid nitrification after doses greater than 0.1 Mrad was most likely to result from oxidation by non-proliferating cells of the nitrifying bacteria, rather than increased proliferation of the survivors. (auth) (UK)

Meteorology

42866 (IDO-17261) USER'S MANUAL FOR THE FORTRAN VERSION OF RSAC. A RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM. Richardson, L. C. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). June 1968. Contract AT(10-1)-205. 140p. Dep. CFSTI.

A user's manual for the FORTRAN version of the RSAC computer code is presented. The mathematical model and equations are described in IDO 17151, RSAC — A Radiological Safety Analysis Computer Program, by R. L. Coates and N. R. Norton, dated May 1966. The program computes the potential radiological doses resulting from either a continuous or instantaneous release of radioactive fission products to the atmosphere. The doses considered are cloud gamma, deposition gamma, ingestion, and inhalation and are based upon the release of up to 450 isotopes, the relative abundance of each isotope being dependent upon the operating history of the nuclear reactor under consideration. (auth)

42867 (GA-8369) HELIUM BUOYANCY AND EFFECTS ON ATMOSPHERIC DILUTION. Sedgley, D. B. (Gulf General Atomic, Inc., San Diego, Calif.). Nov. 15, 1967. Contract AT(04-3)-633. 24p. Dep. CFSTI.

Calculation of an atmospheric dilution factor to be applied to radioactivity contained in a cloud of buoyant gas released during the course of a reactor plant accident depends on the amount of such gas that becomes available for dispersion in the atmosphere. A sample calculation is given based on the maximum accidental helium leak from the Fort St. Vrain reactor plant. Equations for behavior of buoyant gas clouds are given and solved. Effects of atmospheric density lapse rate, wind speed, building downwash, atmospheric stability conditions, and actual cloud outflow velocity on effective atmospheric dilution are discussed. (M.C.G.)

42868 (LA-3887) BETA RADIOACTIVITY IN ENVIRONMENTAL AIR AND PRECIPITATION AT LOS ALAMOS, NEW MEXICO, FOR 1967. Kennedy, W. R.; Aeby, Jack W. (Los Alamos Scientific Lab., N. Mex.). Jan. 1968. Contract W-7405-eng-36. 13p. Dep. CFSTI.

Beta activity of particulate matter in both air and precipitation for 1967 are reported for Los Alamos, New Mexico. The declining activities found in January through April seem to be residual fallout from the 1966 foreign nuclear weapons tests, and the December high to late 1967 efforts. The May through September increases reflect the increasing rainfall of that period. (auth)

42869 (NP-17523) ENVIRONMENTAL RADIOACTIVITY IN NEW ZEALAND AND RESULTS OF EXTENDED MONITORING OF FALLOUT FROM FRENCH NUCLEAR TESTS IN THE PACIFIC. Quarterly Report, October–December 1967. (National Radiation Lab., Christchurch (New Zealand)). 12p. (NRL-F-27). Dep.

A map shows the locations of the collecting stations. The fallout is tabulated for air, milk, and rain samples in aggregate for the country and for individual stations. The results of the extended monitoring of fallout from French nuclear testing in the Pacific are tabulated. (J.C.W.)

42870 (NP-17524) ENVIRONMENTAL RADIOACTIVITY IN NEW ZEALAND AND RESULTS OF EXTENDED MONITORING OF FALLOUT FROM FRENCH NUCLEAR TESTS IN THE PACIFIC. Annual Summary, 1967. (National Radiation Lab., Christchurch (New Zealand)). 40p. (NRL-F-28). Dep.

A map of the collection stations is given. Sample collecting information and evaluation on air, rain, milk, animal thyroids, human bone, and soil are discussed. Measurements of fission products in air and rain and ^{90}Sr in rain are tabulated. ^{90}Sr and ^{137}Cs content in milk are recorded. The results of the monitoring of fallout from French Nuclear Tests in the Pacific are given. ^{137}Cs in milk and the ratio of ^{137}Cs to ^{90}Sr in milk are given. Results of measurements of ^{210}Pb in rain and milk are included along with results of surveys on ^{210}Pb, ^{226}Ra, and ^{90}Sr in human bone. (J.C.W.)

42871 (SC-CR-67-2812) FLUID DYNAMICS ANALOG STUDIES RELATED TO THE DISPERSION OF PARTICLES IN THE UPPER ATMOSPHERE. Final Report. Cote, Owen (GCA Corp., Bedford, Mass. GCA Technology Div.). Mar. 1968. 67p. Dep. CFSTI.

For Sandia Corp., Albuquerque, N. Mex.

Motions produced by thermal convection in a rotating fluid-filled annulus bear similarity to motions in the earth's upper atmosphere. To explore the usefulness of this similation to understanding of transport and mixing processes in the atmosphere, flow visualization experiments using dye traces in the annulus were performed. Valuable qualitative and quantitative information on dispersal rates was obtained which provides insight into similar processes in the atmosphere and compares with other studies of transport and diffusion processes. (auth)

42872 (SC-M-68-191) PAPERS PRESENTED AT THE SYMPOSIUM ON THE THEORY AND MEASUREMENT OF ATMOSPHERIC TURBULENCE AND DIFFUSION IN THE PLANETARY BOUNDARY LAYER, ALBUQUERQUE, NEW MEXICO, DECEMBER 5–7, 1967. (Sandia Corp., Albuquerque, N. Mex.). May 1968. 286p. (CONF-671205). Dep. CFSTI.

Twenty-two papers are included, along with introductions and a panel discussion. The aims of the conference were to survey current thinking in this field and to present recent theoretical developments, experimental results, wind tunnel studies, and developments in instruments and measurement techniques. (D.L.C.)

42873 (UCRL-50428) PROCEDURES FOR THE SYSTEMATIC SEPARATION AND ANALYSIS OF RADIOACTIVE PARTICLES FROM NUCLEAR DETONATIONS. Heft, Robert E.; Steele, William A. (California Univ., Livermore. Lawrence Radiation Lab.). May 17, 1968. Contract W-7405-eng-48. 32p. Dep. CFSTI.

A set of procedures for the systematic separation and analysis of particle groups has been developed for use in a reexamination of early time aerial filter and local fallout samples of radioactive particles from nuclear detonations. The radioactive particles produced by nuclear detonations have radioisotopic compositions which vary with both particle size and type. To determine how individual radionuclides are distributed among the particles, it is first necessary to group the particles according to size and/or type. For the most part, conventional particle analysis techniques do not provide the required separated particle fractions. The range of particle diameters encountered extends from less than 0.01 μ up to several cm. No single separation technique is effective over this entire range. However, all samples fall into one of three narrower range categories for which single procedures do apply. Thus, for all local fallout samples, the majority of particles are in the 100-μ to few-cm dia range. Such samples are size separated by a modified dry sieving technique and density separated by flotation. All aerial filter samples from surface and near surface detonations have particles predominantly in the 1- to 100-μ dia range. These samples are size separated by gravitational sedimentation in stabilized fluid columns which are open at the base so that discrete size fractions can be collected according to time of sedimentation. Density separation is accomplished by density gradient centrifugation. The third category of samples, which includes all aerial filter samples from airbursts, contains particles whose size range is principally between 0.01- and 1.0-μ dia. These are subjected to size separation and density determination by centrifugal sedimentation in stabilized, open bottom, fluid columns. The separated particle groups from all categories of samples are subjected to physical examination and gamma spectrometric analysis for the purpose of determining radioisotopic and mass distribution as a function of particle size for each class of radioactive particle produced by the detonation. (auth)

42874 REMOVAL OF RADIOIODINE FROM GASES. Adams, R. E.; Ackley, R. D. Nucl. Safety, 9: 373-82(Sept.-Oct. 1968).

Certain specially impregnated charcoals were found to be effective for the removal of radioactive methyl iodide (e.g., $CH_3{}^{131}I$) from flowing air and steam-air mixtures at relative humidities much higher than those at which unimpregnated charcoal is effective. These impregnated charcoals are also effective for trapping elemental iodine (I_2). Airborne iodine may also occur in intimate association with particulate material, and studies suggest that both reversible and irreversible adsorption may occur. Consequently, although radioiodine-bearing particulates may be removed with high-efficiency filters, the possible desorption of iodine from the trapped particulates may represent a potential problem. The postaccident use of spray systems and water pools for both pressure control and fission-product removal and in-place testing of iodine-removal systems is discussed. (auth)

42875 INFLUENCE OF COULOMB AND IMAGE FORCES ON COMBINATION IN AEROSOLS. Keefe, D.; Nolan, P. J.; Scott, J. A. (Univ. College, Dublin). Proc. Roy. Irish Acad., Sect. A, 66: 17-29(1968).

The effect of electrostatic image forces on the combination of small ions and charged aerosol nuclei is examined. Collision enhancement factors are derived for small ions with constant velocity. Evaluations are then made taking into account the Maxwellian velocity distribution of the small ions. Collision treatment inside the limiting sphere and diffusion treatment outside are combined by equating the ion flux on the two sides. The resultant combination coefficients give good agreement with the Boltzmann Distribution Law, for radii greater than approximately 1×10^{-6} cm. These coefficients give Whipple-type differences which vary with the nucleus size and which are less than the Whipple difference $4\pi\epsilon_\omega$. For very large nuclei the difference is 0.5 ($4\pi\epsilon_\omega$), for atmospheric size nuclei 0.75 ($4\pi\epsilon_\omega$), and for very small nuclei 0.9 ($4\pi\epsilon_\omega$). (auth)

42876 POSSIBILITIES FOR THE DEFENSE OF MODERN SOCIETY AGAINST POLLUTION OF FOOD AND THE ENVIRONMENT. [PART II.]. Peeters, E.-G. (Institut Europeen de Cancerologie, Brussels). Vitalst. Zivilisationskr., 13: 14-15 (Feb. 1968). (In French).

The principles that should be followed in the enactment of legislation with respect to contamination of food, drinking water, and seas and oceans are briefly indicated. The contamination of the atmosphere is a more urgent problem and is discussed with respect to domestic pollution, vehicular pollution, industrial pollution, and the problem of tobacco. Measurements to be undertaken with respect to radioactivity are considered. Medical radioactivity, radioactivity of the air, radioactivity of the seas and oceans, radioactivity of foods, and professional radioactivity are discussed. (J.S.R.)

42877 NUCLEAR DEBRIS FROM THE SIXTH CHINESE NUCLEAR EXPLOSION OF JUNE 17, 1967. Mamuro, Tetsuo; Matsunami, Tadao. Annu. Rep. Radiat. Center Osaka Prefect., 8: 35-6(1967).

Fresh nuclear debris from the sixth Chinese nuclear explosion of June 17, 1967 were measured γ-ray spectrometrically and the initial atom number ratio of ^{239}Np to ^{237}U was determined to be about 1.8. This was the smallest value of this ratio that we observed in the nuclear debris from the past Chinese explosions. It was thus concluded that the abundance ratio of fast to slow neutrons was the highest in the sixth explosion, suggesting the successful operation of a thermonuclear device. (auth)

42878 SOME LONG-LIVED RADIONUCLIDES IN NUCLEAR DEBRIS. Mamuro, Tetsuo; Matsunami, Tadao. Annu. Rep. Radiat. Center Osaka Prefect., 8: 27-9(1967).

In a γ-ray spectrum measured of the combined 63 isolated hot particles, which were found and collected shortly after a Soviet nuclear explosion, probably an air burst of considerably high yield, in October 1961, was found in addition to the ^{144}Ce photopeaks so conspicuous a photopeak at about 510 keV that seemed to indicate definitely the presence of some long-lived radionuclide in the hot particles. It was assumed that this photopeak was due to the nuclide ^{26}Al, which was probably produced from the Al used as the bomb building materials. In γ-ray spectra measured of old rain water samples, were found the photopeaks due to ^{106}Ru, ^{125}Sb, ^{137}Cs and ^{144}Ce, but the photopeak due to ^{26}Al was not so definitely seen. (auth)

42879 ^{238}Pu IN FALLOUT PARTICLES. Mamuro, Tetsuo; Matsunami, Tadao. Annu. Rep. Radiat. Center Osaka Prefect., 8: 23-6(1967).

Alpha-ray spectrometrical measurement of Pu has been made of isolated hot particles from two Soviet explosions in 1961 and 1962 and four Chinese explosions (the first, the second, the third and the fifth explosions). The nuclide ^{238}Pu was clearly detected in addition to ^{239}Pu and ^{240}Pu in the Soviet hot particles but not in the Chinese fallout. (auth)

42880 URANIUM IN FALLOUT PARTICLES. Matsunami, Tadao; Mamuro, Tetsuo. Annu. Rep. Radiat. Center Osaka Prefect., 8: 18-22(1967).

Alpha-ray spectrometrical measurements of the U content and the activity ratio of ^{234}U to ^{238}U have been made of isolated hot particles (highly radioactive fallout particles) from two Soviet explosions in 1961 and 1962 and four Chinese explosions (the first, the second, the third and the fifth explosions). The U content of the Soviet hot particles was below the detection limit, but the presence of U was clearly detected in the Chinese hot particles and their activity ratio of ^{234}U to ^{238}U was found to be nearly unity. Similar α-ray spectrometrical measurements were also made of some rain water samples and a soil sample. It seems very difficult to estimate the U deposition on the earth surface due to nuclear explosions by measuring the U contents in rain water samples. (auth)

42881 HIGHLY RADIOACTIVE FALLOUT PARTICLES FROM THE FIFTH CHINESE NUCLEAR EXPLOSION OF DEC. 28, 1966. Mamuro, Tetsuo; Matsunami, Tadao; Fujita, Akira; Yoshikawa, Kazuko. Annu. Rep. Radiat. Center Osaka Prefect., 8: 1-17(1967).

The fifth Chinese nuclear explosion of Dec. 28, 1966 is believed to have been a land surface burst of about 200 kton yield. The radionuclide fractionation appearing in individual hot particles (highly radioactive fallout particles) from this explosion has been investigated by γ-ray spectrometry. The activities of the 10 radionuclides, ^{95}Zr, ^{97}Zr, ^{99}Mo, ^{103}Ru, ^{131}I, ^{132}Te, ^{133}Xe, ^{140}Ba, ^{141}Ce and ^{239}Np were determined and the initial atom numbers of these nuclides contained in each sample were estimated. The fractionation factor defined with respect to ^{95}Zr was calculated in order to express the degree of fractionation. The results obtained are discussed in relation to the fission product decay chains and compared with those obtained on the hot particles from former air bursts. It was revealed that there was considerable difference in radiochemical nature between the present hot particles from a surface burst and those from air bursts. Some assumptions concerning the mechanism of fractionation in hot particles are presented, but at present it seems difficult to understand satisfactorily the radionuclide fractionation phenomena which take place in the fireball during the time of particle formation. (auth)

42882 THE QUESTION OF THE RAPID DETERMINATION OF THE CONCENTRATION OF ARTIFICIAL RADIOACTIVITY IN THE AIR ON THE BASIS OF MEASUREMENT RESULTS FROM AN AUTOMATIC AIR MONITORING APPARATUS. Ernst, F.; Moser, F.; Sedlacek, M. Oesterr. Akad. Wiss., Math.-Naturwiss. Kl., Sitzungsber., Abt. II, 176: No. 3, 139-67(1967). (In German).

The effect of natural background radiation on the rapid determination of fallout concentration in the lower atmosphere is discussed. The rapid determination methods include sampling dust on a filter without waiting for the complete decay of the natural background radiation using γ-spectroscopy, α-β-pseudo-coincidence, or similar techniques. The methods developed are based on natural radioactivity data collected through a number of years by a fully automated dust sampling unit, and permit detection of fallout concentration of about 100 pCi/m^3 three hours after the end of the aerosol concentrating process with an error of only a few percent. (auth)

42883 MICROBAROGRAPHIC OSCILLATIONS PRODUCED BY NUCLEAR EXPLOSIONS AS RECORDED IN GREAT BRITAIN AND EIRE. MacKinnon, R. F. (Imperial Coll. of Science and Tech., London). Quart. J. Roy. Meteorol. Soc., 94: 156-66(Apr. 1968).

Previously unpublished microbarographic data associated with atmosphere thermonuclear tests in the Marshall Islands and in the Soviet Union from 1954 to 1962 are presented. Two types of barograms recorded in Great Britain and Eire were studied: the Shaw-Dines microbarograph and the Dines float barograph operated at Eskdalemuir, Lerwick, and Kew Observatories and at Valentia in Eire. Results demonstrated that the effects of winds on maximum amplitudes of microbarographic oscillations are most important in the estimation of the size of explosions. The 30 October 1961 explosion, evidently the largest-ever nuclear explosion, was used as the standard. However, for waves recorded in the British Isles, larger maximum amplitudes were recorded on 2 other days, 5 August 1962 (40-Mt explosion) and 27 September 1962 (32-Mt explosion). An explanation of this lies in the existence of strong westerly winds over northern Europe and Asia on 30 October 1961, possibly above an altitude of 20 km as well as below. These winds opposed propagation towards the British Isles, reduced wave speeds and the maximum amplitude of the wave-train in comparison with the speeds and maximum amplitude of waves travelling with the winds towards Japan. Maximum amplitudes of microbarographic oscillations for the explosions of 23 October 1961 and 22 October 1962 were reduced by half or more in comparison with those of 25 September, 27 September, and 24 December 1962 which were explosions of roughly the same size (30 Mt). Comparisons of maximum amplitudes of antipodal (A_2 and A_3) waves recorded in Japan and in the British Isles for the same explosions showed that the larger amplitude was not generally associated with the larger wave speed. Thus there was no clear direct relation between wave speed and maximum amplitudes for the total wave-train, or between maximum amplitudes and jet-stream winds. Winds above the jet-stream play an important part in determining amplitudes of pressure waves at ground level. (BBB)

42884 STUDIES OF AIR-POLLUTION USING TRACERS. Dahl, J. B. (Institutt for Atomenergi, Kjeller, Norway). Tidsskr. Kjemi, Bergv. Met., 28: 109-11(May 1968). (In Norwegian).

A simple inactive tracer method has been developed for the study of the field distribution of gaseous air contaminants emitted from stacks. Tracer gas indium oxide particles are used, with diameters in the region of 0.01 to 0.1 micron. The particles are formed by combustion of an alcoholic solution of indium nitrate in an ordinary oil burner. Samples of the tracer gas, which is mixed with the stack gas to be studied, are collected in small plastic trays filled with water. The contents of indium in the samples are determined by neutron activation analysis. The method, which is very sensitive and selective, is useful for studying the distribution of gases emitted from a particular stack or for the determination of the gas emission from planned stacks. (auth) (Norway)

42885 ^{90}Sr ON THE EARTH'S SURFACE. Hardy, E. P. (Atomic Energy Commission, New York); Meyer, M. W.; Allen, J. S.; Alexander, L. T. Nature (London), 219: 584-7(Aug. 10, 1968).

Estimations of the amount of strontium-90 on the earth's surface indicate that maximum fallout occurred late in 1966. Of the 13 MCi recorded at the beginning of 1967, 82 percent of this was in the northern hemisphere. (auth) (UK)

Mineralogy and Exploration

Refer also to abstracts 42851, 43311, 43811, and 44261.

42886 (TT-67-58017/3-4) MINING AND METALLURGY QUARTERLY. Translation of Rudarsko Met. Zbornik, No. 3/4, 225-74(1967). 63p. CFSTI.

Seven articles are presented on flotation of minerals, percussion rock drills, steel supports for mine galleries, and treatment of phenol wastes. A separate abstract was prepared for one article. (P.G.C.)

For an abstract of the individual section see: 43633.

42887 IODINE AND URANIUM IN ULTRABASIC ROCKS AND CARBONATITES. Becker, V.; Bennett, J. H.; Manuel, O. K. (Univ. of Missouri, Rolla). Earth Planet. Sci. Lett., 4: 357-62 (July 1968).

A series of ultrabasic rocks and carbonatites were analyzed by neutron activation for iodine and uranium. The uranium data are compared with earlier data on the uranium content of possible mantle material. The high uranium content of the carbonatites, 0.80 to 8.0 ppM, indicates that these may make a sizeable contribution to the average terrestrial heat flow. The iodine and uranium data are compared with the iodine and uranium contents of stone meteorites and with the xenon decay products of extinct ^{129}I and ^{244}Pu in the meteorites. The concentrations of these decay products in the atmosphere are used to show that the earth began to retain these gaseous products as early as the eurite achondrites. (auth)

42888 VEIN SOLID BITUMENS IN URANIUM DEPOSITS. Zubov, A. I.; Kotel'nikov, G. N. At. Energ. (USSR), 24: 514-19(June 1968). (In Russian).

Principal features of the geological structure of a vein hydrothermal uranium deposit containing solid bitumens are described; some peculiarities of the search for such deposits are reported. The mineral composition of ores is characterized. It was found that the solid bitumens had been formed after the formation of the pitchblende I and pitchblende II breaking up the latter into separate debris and had preceded the formation of sulphide-dolomite veins. (auth)

42889 ADVANTAGES OF UNDERGROUND LEACHING OF URANIUM FROM WATER-BEARING URANIUM DEPOSITS. Gubkin, N. V.; Desyatnikov, D. T.; Rudneva, I. K. At. Energ. (USSR), 24: 511-14(June 1968). (In Russian).

The advantages of the uranium ore underground leaching methods are described. It is shown that water-bearing deposits being unfavorable in ordinary mining become feasible when using underground leaching methods. When using this method there is no need for drainage of the whole deposit or its separate parts. (auth)

Oceanography

Refer also to abstracts 42975 and 43311.

42890 (CU-2663-9) MIXING, DIFFUSION, AND CIRCULATION RATES IN OCEAN WATERS. Annual Progress Report No. 9, 1967-1968. (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory). June 1968. Contract AT(30-1)-2663. 425p. Dep. CFSTI.

A separate abstract was prepared for each of the 23 included papers on the mixing, diffusion, and circulation rates in ocean waters. (J.C.W.)

For abstracts of individual papers see: 42891-42913.

42891 (CU-2663-9, App.A) INTERCHANGE OF WATER BETWEEN THE MAJOR OCEANS. Broecker, Wallace S.; Li, Yuan-Hui (Columbia Univ., Palisades, N. Y.). 17p.

The major oceanic water types analyzed for rates at which mixing takes place are the North Atlantic deep water, the Pacific and Indian deep water, and the warm surface water. A mathematical model for the interchange of water is presented. Concentrations of carbon-14 and total dissolved inorganic CO_2 data and assumptions made for the model calculations are discussed. (J.C.W.)

42892 (CU-2663-9, App.B) NATURAL RADIOCARBON AND FISSION PRODUCTS IN ARCTIC OCEAN WATER. Thurber, D. L.; Mathieu, Guy; Hunkins, Kenneth (Columbia Univ., Palisades, N. Y.) 21p.

Three types of Arctic Ocean water are Arctic surface water, Atlantic water, and Arctic deep water. Radiocarbon measurements made in all areas indicate Arctic Ocean water masses origin. A comparison of data at time intervals before and after nuclear explosions indicates water movements. The ^{137}Cs concentrations are in concordance with predictions from radiocarbon data. (J.C.W.)

42893 (CU-2663-9, App.C) SUMMARY OF LAMONT ^{90}Sr AND ^{137}Cs MEASUREMENTS ON OCEAN WATER SAMPLES. Broecker, Wallace S.; Simpson, H. James (Columbia Univ., Palisades, N. Y.). 23p.

It is concluded that rapid, deep penetration of ^{90}Sr and ^{137}Cs is a local phenomena unrelated to large scale ocean mixing. Results of sampling from the Antarctic, Atlantic, and Pacific Oceans and the Caribbean Sea are tabulated for analyses of ^{90}Sr and ^{137}Cs contents. (J.C.W.)

42894 (CU-2663-9, App.D) RATES OF VERTICAL EDDY DIFFUSION NEAR THE OCEAN FLOOR BASED ON MEASUREMENTS OF THE DISTRIBUTION OF EXCESS ^{222}Rn. Broecker, W. S.; Cromwell, J.; Li, Y. H. (Columbia Univ., Palisades, N. Y.). 15p.

Measurements of the vertical distribution of radon for 13 near bottom profiles in the Pacific and South Atlantic Oceans and the Caribbean Sea were made. Results of the radon measurements are summarized. If vertical mixing in the near bottom ocean is accomplished by eddy diffusion then the concentration of excess radon will vary with distance above the sediment-water interface. (J.C.W.)

42895 (CU-2663-9, App.E) VERTICAL DISTRIBUTION OF BARIUM IN THE PACIFIC OCEAN. Wolgemuth, Kenneth M. (Columbia Univ., Palisades, N. Y.). 24p.

The vertical distribution of barium has been determined in the northeast and the equatorial Pacific by the isotope dilution method. The concentration at the surface is about 10 μg/l and increases regularly with depth to about 30 μg/l in the deep ocean. The distribution is interpreted as being controlled by ocean circulation and downward transport by biologically generated particulate matter. A box model is presented to describe the marine geochemistry of barium. A distinct correlation exists between the vertical distribution of barium and radium. This suggests that radium-226 cannot, by itself, be used in connection with studies of ocean circulation. (auth)

42896 (CU-2663-9, App.F) ULTRASENSITIVE METHOD FOR MEASURING THE IN SITU SOLUBILITY OF CALCITE AND OTHER MINERAL PHASES. Horowitz, Ross (Columbia Univ., Palisades, N. Y.). 14p.

The solubility of aragonites and calcites in sea water is studied. It was observed that an increase in the dissolution of calcite with depth occurred. An ultrasensitive method for measuring the solubility is discussed. The new procedure includes measuring the ^{14}C activity in water which has passed over calcite. Equipment designs are presented. (J.C.W.)

42897 (CU-2663-9, App.G) OXYGEN ISOTOPE COMPOSITIONS OF FORAMINIFERA AND WATER SAMPLES FROM THE ARCTIC OCEAN. van Donk, Jan; Mathieu, Guy (Columbia Univ., Palisades, N. Y.). 25p.

Gravity cores and water samples from the Arctic Ocean were collected and tested to determine if the Arctic Ocean were open during part of each glacial period. The ^{18}O/^{16}O ratio and the salinity would be different from present values. Salinity in the Arctic Ocean is controlled by precipitation, evaporation, runoff, and exchange with adjacent water. The ^{18}O content is influenced by these factors. The change in ^{18}O/^{16}O ratio of water is expected to be reflected in the ^{18}O/^{16}O ratios of the calcareous tests of the foraminifera living in equilibrium with the water in glacial periods. (J.C.W.)

42898 (CU-2663-9, App.H) MODIFICATION OF AN INTERNALLY-RECORDING CURRENT METER FOR BOTTOM CURRENT MEASUREMENTS. Gerard, R. (Columbia Univ., Palisades, N. Y.). 15p.

A deck-lowered recording current meter for use near the ocean bottom is described. A measurement was made in the channel believed to connect the Argentine and Brazil Basins. The measurement of Antarctic Bottom Current agrees with previous geostrophic computations. (J.C.W.)

42899 (CU-2663-9, App.I) DYE TRACER EXPERIMENTS AND HYDROGRAPHIC OBSERVATIONS IN THE VIRGIN ISLANDS BASIN. Gerard, R.; Ichiye, T. (Columbia Univ., Palisades, N. Y.). 17p.

The characteristics of underwater explosions in depths between 150 and 600 ft are investigated. Charges used were from 1500 to 13,000 lbs. To study the physical effects in the marine environment of explosions, the diffusion of dye tracers in and around the explosive charges were mixed with the explosion products and this pattern was observed. (J.C.W.)

42900 (CU-2663-9, App.J) PRELIMINARY ANALYSIS OF ELTANIN CRUISES 25 THROUGH 27 STD DATA. Gordon, Arnold L. (Columbia Univ., Palisades, N. Y.). 12p.

Measurements taken in Antarctic Waters are presented in graphical form. The STD (salinity-temperature-depth) recorder afforded an inspection of the microstructure in a water column at a given location. (J.C.W.)

42901 (CU-2663-9, App.K) BACKGROUND FOR THREE-COMPONENT CURRENT MEASUREMENTS. Ichiye, T.; Gerard, R. (Columbia Univ., Palisades, N. Y.) 3p.

Plans to measure ambient temperatures in the channel approaches to New York Harbor with a rapid response single-crystal type thermistor probe are reported. Corollary instrumentation for ocean current measurement consisting of a three-axis probe using small conical hot film sensors is described. The three current signals and the temperature signal will be simultaneously recorded on a four-channel chart recorder. (J.C.W.)

42902 (CU-2663-9, App.L) DESIGN AND TESTING OF AN ELECTRIC-READOUT NEPHELOMETER. Marshall, N. K.; Gerard, R. (Columbia Univ., Palisades, N. Y.). 11p.

The NPH-1 prototype nephelometer was calibrated and shallow-water testing proved its performance satisfactory. A deep-water immersion test down to 1200 meters resulted in premature failure due to low temperature and rapidly dropping battery voltage. Sealing and structural portions remained intact. Design shortcomings below 5°C and inadequate battery performance beyond 3 hours of operating time were revealed. (J.C.W.)

42903 (CU-2663-9, App.M) STD HYDROGRAPHIC STATIONS IN THE BLAKE-BAHAMA OUTER RIDGE AREA OF THE WESTERN NORTH ATLANTIC. Amos, A. (Columbia Univ., Palisades, N. Y.). 9p.

Salinity, temperature, and depth measurements were made of the deep and bottom water in a transect from the Blake Plateau across the Blake–Bahama Outer Ridge and into the Hatteras Abyssal Plain area. Movement of bottom currents in this area is studied. (J.C.W.)

42904 (CU-2663-9, App.N) NORTH PACIFIC BOTTOM POTENTIAL TEMPERATURE DISTRIBUTION AND COMMENTS ON THE MAIN PATTERN OF CIRCULATION. Gordon, Arnold L. (Columbia Univ., Palisades, N. Y.). 11p.

The pattern of flow of the North Pacific bottom water is discussed. Data on the potential temperature and the T_p/O_2 relation of the bottom waters are discussed and the basic trend of bottom water spreading is deduced. A unique process is indicated in the North Pacific which is strong upwelling at great depths, indicating that this ocean may be a major region of transfer of cold deep water to the warmer surface layer. (J.C.W.)

42905 (CU-2663-9, App.O) CIRCUMPOLAR SALINITY MAXIMUM CORE LAYER. Gordon, Arnold L. (Columbia Univ., Palisades, N. Y.). 12p.

A circumpolar antarctic deep water salinity maximum core layer map has been prepared. The general characteristics of the deep water are investigated. (J.C.W.)

42906 (CU-2663-9, App.P) ANALYSIS OF STD DATA IN THE INDIAN OCEAN. Gordon, Arnold L. (Columbia Univ., Palisades, N. Y.). 9p.

Methods are described for the analysis of salinity, temperature, and depth data of the Indian Ocean. (J.C.W.)

42907 (CU-2663-9, App.Q) AIR-DROP DYE EXPERIMENTS, 1967 TO 1968. Gerard, R.; Gordon, A. L. (Columbia Univ., Palisades, N. Y.). 29p.

Horizontal turbulence in the upper Ekman layer of the Atlantic Ocean and Caribbean Sea under varying wind and sea-state conditions was investigated. The proceedings of the air-drop dye experiments are described. Air-droppable buoys which anchor in depths of a few hundred feet of water disperse dye at several depths between the surface and 10m depth. Dye plumes are photographed from aircraft. (J.C.W.)

42908 (CU-2663-9, App.R) ROTATING MODEL EXPERIMENTS OF THE CIRCULATION IN THE CARIBBEAN SEA. Ichiye, Takashi (Columbia Univ., Palisades, N. Y.). 9p.

The driving forces of the circulation of the Caribbean Sea are inflow from the North Atlantic Ocean and outflow into the Gulf of Mexico and wind stresses of the trade wind. A scale model of the Caribbean Sea was built and enclosed in a plexiglass circular tank. Wind was simulated. Equations of motion of circulation in oceans are expressed. Preliminary results of experiments using the model indicate the importance of bottom topography and seasonal changes of the wind system to the circulation. (J.C.W.)

42909 (CU-2663-9, App.S) THE USE OF COMMAND SAMPLERS FOR QUALITY CONTROL OF IN-SITU SALINITY/TEMPERATURE/DEPTH (STD) RECORDER DATA. Amos, A. F. (Columbia Univ., Palisades, N. Y.). 10p.

Salinity-temperature-density systems reveal new qualitative descriptions of the microstructure in the oceans. By using command-type samplers with the STD, accurate quantitative data can be obtained for computing the dynamic relationships of these microstructures. The Surface-actuated Multiple Sampler (SAMS) and the Niskin or Rosette sampler are used in the studies of the Western Atlantic, Caribbean, Tasman Sea, Ross Sea, and South Pacific waters. (J.C.W.)

42910 (CU-2663-9, App.T) THEORY ON GENERATION OF GIANT BOTTOM UNDULATIONS. Ichiye, Takashi (Columbia Univ., Palisades, N. Y.). 12p.

Two dynamical models for generation of ocean bottom undulations are proposed. One model is based on the premise that the internal waves in the nepheloid layer are the generating force. The motion causing erosion and deposition is variable with time. The second model is based on the consideration that perturbation of a stationary current causes erosion and deposition of the bottom sediment. Results of experiments relating to bottom perturbation, made with a rotating tank are discussed. (J.C.W.)

42911 (CU-2663-9, App.U) DYNAMICS OF MEANDERS OF THE KUROSHIO AND THE GULF STREAM. Ichiye, Takashi (Columbia Univ., Palisades, N. Y.). 26p.

A review is presented on observations and theories of the meanderings of the Gulf Stream and the Kuroshio. Comparisons are discussed. (J.C.W.)

42912 (CU-2663-9, App.V) NOTE ON CONVECTION CURRENT IN THE MANTLE. Ichiye, Takashi (Columbia Univ., Palisades, N. Y.). 8p.

The hypothesis of convection in the earth mantle is reviewed. In the mathematical analysis, the dissipation term is not negligible in the heat equation of convection in the mantle. The modification of the temperature distribution due to this term can be expressed as a solution of the heat equations with a known heat source in the upper and lower thermal boundary layer. The method is not applicable to the vertical thermal plumes of the convection cell. (J.C.W.)

42913 (CU-2663-9, App.W) PRELIMINARY ANALYSIS OF SUBSURFACE DYE-PLUME EXPERIMENTS IN THREE OCEAN AREAS. Costin, J. Michael (Columbia Univ., Palisades, N. Y.). 29p.

Measurements of dye plume diffusion were made with a fluorometer off the coast of Cape Hatteras, in the Tongue of the Ocean in the Bahamas, and north of Abaco Island. Experimental procedures are described and the data analyzed. (J.C.W.)

42914 (NYO-2174-77) FALLOUT ^{90}Sr IN ATLANTIC OCEAN SURFACE WATERS. Bowen, Vaughan T.; Noshkin, Victor E.; Volchok, Herbert L.; Sugihara, Thomas T. (Woods Hole Oceanographic Institution, Mass.). July 1, 1968. Contract AT(30-1)-2174. 52p. Dep. CFSTI.

The distribution of ^{90}Sr in surface waters of the Atlantic Oceans, both North and South was analyzed. Information was derived from the patterns of relative concentrations in waters of 10° latitude bands in individual years, from the changes in these patterns from year to year, especially in light of changes in the rate of fallout delivery, and from correlation of concentrations measured at points sampled on regular schedules, with the current patterns which connect these points. All these lines of evidence indicate that the latitudinal distribution of fallout delivery to the Atlantic sea surface has been quite different from that over land, and much more variable from year to year. The rate of reduction in ^{90}Sr concentration in surface waters, as the rate of annual addition of new fallout fell to less than 15%, indicates the average annual rate of loss of ^{90}Sr from the surface ocean must exceed 20%. In view of this considerable rate of tracer removal, the high levels of ^{90}Sr concentration seen in surface water appear possible only if the over-ocean fallout delivery per unit area exceeds that over comparable land latitudes by a very considerable amount. The behavior of ^{90}Sr in surface water thus substantially confirms conclusions previously drawn from study of the rather small number of vertical profiles of concentration. (auth)

42915 (NYO-2174-87) GENERAL SUMMARY OF PROGRESS [ON OCEANOGRAPHY]. [Bowen, V. T.] (Woods Hole Oceanographic Institution, Mass.). June 1968. Contract AT(30-1)-2174. 33p. Dep. CFSTI.

Progress is reported on oceanographic research. The collection of samples of surface seawater, plankton, and sediments for analysis in the northern Sargasso Sea is described. The analysis of subsurface ocean water for fission products is discussed under the following headings: penetration of fallout ^{90}Sr into deep water of the Atlantic Ocean; activation analyses of trace elements in over-ocean aerosols; activation analyses of stable isotope ratios; non-lanthanide trace elements in modern corals; and emission spectrometric analyses of marine rocks and sediments. (R.C.K.)

42916 ACCRETION RATE OF COSMIC MATTER FROM IRIDIUM AND OSMIUM CONTENTS OF DEEP-SEA SEDIMENTS. Barker, John L. Jr.; Anders, Edward (Univ. of Chicago). Contract AT(11-1)-382. Geochim. Cosmochim. Acta, 32: 627-45(June 1968). (COO-382-7).

Iridium and osmium concentrations were measured in dated deep-sea sediments by neutron activation analysis to attempt to set limits on the influx rate of cosmic matter. Twenty-one measurements on five cores from the central Pacific gave Ir and Os contents from 0.06 to 0.4 ppb, with an observed precision of ±15%. The Ir and Os contents were correlated with each other: Ir = (1.2 ± 0.2)Os. Both tended to increase with decreasing sedimentation rate. The Ir content can be represented by the expression: Ir (ppb) = $(0.07 \pm 0.08) + (0.094 \pm 0.047)1/r_s$ where r_s is the sedimentation rate in mm per 1000 years from ^{230}Th/^{232}Th ratios. If the first term is interpreted as an average terrestrial component, and the second term as an exclusively cosmic component which is diluted in proportion to the sedimentation rate, an upper limit to the influx rate of cosmic matter may be established on the basis of the average Ir content of some representative meteoritic material. With an assumed Ir content of 0.42 ppM, the value in Type I carbonaceous chondrites, the influx rate for the entire earth becomes $(6 \pm 3) \times 10^4$ tons/yr. This value represents an average over the last 10^5 to 10^6 years; the mass range effectively sampled by this method is $\sim 10^{-14}$ to $\sim 10^{12}$ g. A firm upper limit on the influx rate can be obtained by assuming that all the Ir and Os in deep-sea sediments is of cosmic origin. The value obtained is between 0.5×10^5 and 1.5×10^5 tons/yr. It is more than an order of magnitude lower than other estimates based on the Ni content of deep-sea sediments or particles counts by satellites. (auth)

42917 TRACERVERFAHREN ZUR MESSUNG DER FESTSTOFFBEWEGUNG IM WASSER. II BAND. ORIGINALBERICHTE ZUR ARBEITSSITZUNG SITZUNGSPROTOKOLL DER ARBEITSSITZUNG DES BUERO EURISOTOP. (Tracer Methods for the Measurement of Solid Motion in Water. Volume II. Original Papers at the Work Sessions). Informationsheft des Buero Eurisotop 8. Serie: Sitzungsberichte-2. Brussels, Buero Eurisotop–Euratom, 1965. 479p. 20 D.M.

The 29 original papers presented on tracer techniques for the measurement of the movement of solids in water are compiled. The topics discussed include the problems of the use of the Schelde Estuary as an inlet to the Antwerp harbor, origin of dunes and furrows in models of flow patterns, measurement problems in sand migration measurements using radioisotopes, transport of solids in flow under pressure, measurement of solid infiltration in water flows, methods for the use of fluorescence indicators in the study of the development of Belgian beaches, sand migration measurements with radioisotopes on the German coast, measurement of the drift of mud with radioactive scandium glass, importance of the selection of the type and granulometry of radioactive indicators, methods for labeling of natural sand samples with radioactive tracers, use of ^{192}Ir in the study of sediment motion, techniques for the radioactive labeling in sand migration studies, handling and introduction of labeled materials, sand migration measurements in German coastal waters, development of an electronic measurement installation for helicopter, methods for measurement of radioactive depositions in situ, evaluation of measurements of the natural radiation level, determination of the residence time of activated sludge in purification plants, measurement of solid infiltration, quantitative determination of sand migration, inlet of water currents into the ocean, risks and protection in the use of radioisotopes, radioactive labeling of sludge, and the use of artificial radioisotopes in the measurement of the motion of sand. (J.S.R.)

42918 TRACERVERFAHREN ZUR MESSUNG DER FESTSTOFFBEWEGUNG IM WASSER. I BAND. KURZFASSUNG DER BERICHTE UND DISKUSSIONSBEITRAGE. (Tracer Methods for the Measurement of Solid Motion in Water. Volume I. Summary of the Reports and Report Discussions. Informationsheft des Buero Eurisotop 7. Serie: Sitzungsberichte-1. Brussels, Buero Eurisotop–Euratom, 1965. 161p. 10 D.M.

Summaries are presented of the papers given at the ten sessions of the conference. The topics of the sessions were the importance of the study of the motion of solids in water (general questions of a technological and scientific type), physical bases of the motion of solids in water and the problems of measurement technology, measurement methods without use of radioactive materials, experiences gained in the use of radioactive methods within and outside the European Community, labeling techniques and testing for labeled substances, handling and introduction of labeled substances, analysis of results obtained by use of isotopes, nuclear measurement methods not depending on radioactive labeling, costs and economies of radioactive methods, dangers and protective methods in radioisotope use, limitation of the application of isotope methods with respect to other methods, and techniques for the dissemination of knowledge on the advantages of isotope methods and studies for the improvement of isotope technology. The discussions by participants are also reported. (J.S.R.)

42919 APPLICATION OF THE IN SITU GAMMA SPECTROMETRY METHOD IN OCEANOGRAPHY. Chesselet, Roger (CNRS, Gif-sur-Yvette, France). Rev. Int. Oceanogr. Med., 5: 5–21 (1967). (In French)

A method is described whereby very low concentrations of some gamma emitters may be directly measured in the sea. The measuring equipment, which consists mainly of a submarine shell containing the gamma detector, is described. The study of the principal factors which characterize this method is also discussed, e.g., the shielding effect of the seawater for cosmic rays and the detection efficiencies in a medium with homogeneous and infinite source. The use of this method enabled numerous observations on the distribution of ^{95}Zr, ^{95}Nb, ^{103}Ru, and ^{106}Ru in surface waters of the Western Mediterranean and the Bay of Biscayne. It was shown that, for these elements which are present in artificial radioactive fallout, the mixing depth is closely connected to that of the thermocline. Moreover, an accumulation process at the level of the thermocline was observed. The values for the diffusion coefficients have been found to be close to those of the thermal eddy diffusion coefficients. The existence of vertical "partitioning" in the mass of the surface waters of the Bay of Biscayne was shown. A comparative study showed that the rate of radioactive fallout over the sea was 2 or 3 times greater than that over the neighboring land. Several explanations of this fact are discussed. (auth)

ENGINEERING

Nuclear Explosions

42920 (CONF-680908-1) STRUCTURAL STABILITY OF LARGE CAVITIES FOR PROJECT PAYETTE. Nair, Keshavan; Otus, Mahmut (Fenix and Scisson, Inc., Tulsa, Okla.). July 1968. Contract AT(26-1)-38. 40p. Dep. CFSTI.

From Fall Meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers, Minneapolis, Minn.

In connection with Project Payette, which is concerned with the detection of underground nuclear explosions, it was necessary to determine the technical feasibility of constructing and maintaining a large (approximately 315 feet in diameter) unsupported underground cavity at a depth of approximately 2700 feet in the Tatum Salt Dome in Mississippi. The dimensions and the location of the cavity in the salt dome were governed by criteria laid down by the Atomic Energy Commission. Within the framework of the specified criteria, cavities of various shapes and dimensions could be utilized. One aspect of the feasibility study was to investigate the structural stability of various cavity shapes and to recommend a preferred shape. The studies that were conducted to evaluate the structural stability of various proposed cavities is summarized. (auth)

42921 (CONF-680908-2) PROJECT PAYETTE: PROPOSED CONVENTIONAL MINING METHOD FOR THE CREATION OF A 315-FOOT DIAMETER UNSUPPORTED SPHERE AT A DEPTH OF 2700 FEET. Stone, Ronald B. (Fenix and Scisson, Inc., Tulsa, Okla.). July 1968. Contract AT(26-1)-38. 36p. Dep. CFSTI.

From Fall Meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers, Minneapolis, Minn.

A proposed solution to the problem of mining a 315 ft dia unsupported sphere at a depth of 2700 ft in a salt dome by conventional mining methods is described. The proposed solution utilizes many of the varied technologies available for solving mining and underground construction problems. The following aspects of the problem are considered: the location of the sphere within the dome as required by construction criteria; the relation of the location of the access shafts to the sphere; the rock mechanics theory in relation to the salt dome and large size of the excavation; the proposed "honeycomb" method of mining which will be a partial answer to rock mechanics stability requirements; the equipment which it is recommended be utilized to accomplish the construction; the rock mechanics measuring instruments proposed; and the methods of disposal of the mined salt. Conclusions and areas of further study are outlined. (auth)

42922 (CONF-680908-3) THE GEOLOGY OF TATUM SALT DOME, LAMAR COUNTY, MISSISSIPPI. Summers, George E. (Fenix and Scisson, Inc., Tulsa, Okla.). July 1968. Contract AT(26-1)-38. 20p. Dep.

From Fall Meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers, Minneapolis, Minn.

A salt dome appears to provide the basic medium requirements for the excavation of the 315 ft dia, unsupported spherical cavity at a depth of 2700 ft required by the AEC in a proposed "decoupling" experiment. Tatum Salt Dome was a natural choice for a site because more geological and hydrological information has been accumulated on Tatum than any other salt dome on the Gulf Coast. The Tatum dome is a mile in diameter, roughly flat topped, nearly cylindrical in shape and has some overhang at the top. The salt stock has nearly vertical layering of alternating bands of salt and anhydrite. In the vicinity of the dome, adequate fresh water for solution mining is available in surface streams and in subsurface aquifers. A saline aquifer is available for brine disposal. A tentative cavity location was selected near the center of the dome which meets the design criteria established by the AEC. (auth)

42923 (NVO-38-14) COOLING AND VENTILATION OF CONVENTIONALLY MINED CAVITIES USING COOLED COMPRESSED AIR. Ash, J. L. (Fenix and Scisson, Inc., Las Vegas, Nev.). July 1968. Contract AT(26-1)-38. 175p. Dep. CFSTI.

This study was undertaken to determine, if possible, the most practical method for cooling and ventilation that would allow the conventional mining of a cavity below the casing at the bottom of a drilled shaft. Due to space requirements, there are only two practical possibilities for suitably cooling the cavity location of the shaft area. These are to use cooled compressed air piped to the cavity location and waiting the necessary length of time to allow the heat flow from the rock strata to decrease sufficiently to permit mining operations; and to use freeze holes drilled from the surface around the perimeter of the cavity area for cooling the rock strata prior to mining and then use compressed air for ventilation while mining. Because the second possibility also involves many other problems, the first possibility would be the more desirable if the periods of waiting time that would be necessary are not thought to be excessive. This study considered only that condition where cooled compressed air was used for cooling and ventilating the cavity location of the shaft. The necessary equations for theoretically determining the air temperature at various locations in the ventilating system were derived and then solved. Tables were made from the answers obtained and then a series of graphs were drawn from the tables. By using the appropriate graphs, it becomes relatively easy to determine the temperature of the air at any of several significant locations within the system after any period of time up to a year after cooling is commenced under the various conditions that were assumed for this study. In addition, graphs for determining the radial temperature distribution within the rock strata surrounding the shaft were also drawn. It was concluded that: cooling of the cavity area at the bottom of a drilled shaft by means of cooled compressed air is practical, but expensive; although the surface temperature of the rock strata can be cooled down sufficiently in a relatively short period of time, this cooling effect does not extend into the rock for any appreciable distance. As a result of this, after each round is blasted free from the rock, the temperature of the newly exposed rock surface can be expected to be very close to that of the original virgin rock temperature; each problem will have to be solved individually because of the variance in initial conditions. This will not be too difficult, however, using the graphs and, if necessary, the computer program that has been developed from this study. (auth)

42924 (PNE-512-F) AIR-BLAST MEASUREMENTS. Project PRE-SCHOONER II. Reed, Jack W.; Vortman, Luke J. (Sandia Corp., Albuquerque, N. Mex.). Sept. 1967. 60p. Dep. CFSTI.

Air blast resulting from detonation of 85.5 tons of nitromethane buried 71 feet in rhyolite rock was measured close-in, both along the ground and in a vertical field above the explosion, and also at long distances from the explosion. Close-in air-blast wave forms consisted of two positive pulses, the first induced by the ground shock and the second, larger, pulse from venting gas. Measured ground-shock-induced peak overpressures were larger than anticipated. Peak over-pressures from venting gas likewise were larger — so much so that the system was over-ranged, resulting in loss of many of those peaks and degrading the results. A tentative overpressure and energy distribution in the field above the explosion was derived. Air-blast transmission to a large distance was about the same as experienced on other large HE explosions at comparable burial depths. Since the state of the art of neither close-in air blast nor large-range propagation was advanced appreciably, no significant conclusions are presented. (auth)

42925 (TID-24625) PROJECT PAYETTE: PROPOSED SOLUTION MINING PROGRAM FOR THE CREATION OF A 315-FOOT DIAMETER UNSUPPORTED SPHERE AT A DEPTH OF 2,700 FEFT. Allen, Kermit Jr. (Fenix and Scisson, Inc., Tulsa, Okla.). July 1968. Contract AT(26-1)-38. 20p. Dep.

The feasibility of constructing an unsupported 315 foot diameter spherical cavity at a depth of 2,700 feet in a salt dome was investigated. A cavity of this size and shape has never been attempted. It was determined that the three basic essentials for solution mining; adequate salt, fresh water, and a means of brine disposal were available at the Tatum Salt Dome in Lamar County, Mississippi. Assuming a large, unsupported mined opening of the size and at the depth required would remain stable, the most practical method of providing the cavity using solution mining techniques is by use of a movable blanket of air to control the water level to properly shape the cavity while removing the insolubles either with jetting or by conventional mining methods. It is estimated that, using the jetting method of insolubles removal, the cavity can be constructed in 24 months for approximately $7 million. Using conventional mining techniques to remove the insolubles and shape the final cavity, it is estimated that the cavity can be constructed in 36 months for approximately $12.6 million. (auth)

42926 (UCRL-13354) ECONOMICS OF UNDERGOUND GAS STORAGE IN CAVITIES CREATED BY NUCLEAR EXPLOSIVES. Final Report. Witherspoon, P. A.; De Pasquale, D. L. (California Univ., Berkeley. Coll. of Engineering). July 1968. Contract W-7405-eng-48. 103p. Dep. CFSTI.

The possibility of obtaining substantial savings by storing natural gas underground in cavities created by nuclear explosives was explored. The magnitude of these savings will depend on a number of basic factors such as: cost of pipeline gas, weather pattern, and size of the residential heating load. Using the weather pattern for the Chicago area, a computer program was developed that permitted the selection of optimum design conditions for a given heating load and any combination of the variables under consideration. The effects of the basic cost of gas, distance from load point to storage site, maximum storage pressure, storage reuse factor, and cost of site safety program were each investigated. The economics of nuclear storage compare very favorably with those of liquefied natural gas (LNG) storage, which is currently receiving much attention in the United States. With storage volumes (or turnover) of 2 to 4 billion cubic feet, investment costs for LNG storage are about $5.00 per MCF, whereas nuclear storage costs range from $2.00 to $3.00 per MCF. The total annual costs of supplying gas from LNG storage are about $1.00 per MCF, whereas nuclear storage costs are only about $0.40 per MCF. Translating these costs into savings that could be realized for a company with an annual sales volume of 37 billion standard cubic feet, it was found that significantly greater savings could be obtained using nuclear storage. Consequently, the annual rate of return on investment using nuclear storage is much more favorable than for LNG storage. In some cases, the return on investment from nuclear storage is five times that of LNG storage. One of the prime needs for gas storage is in the coastal regions of the United States, particularly in the New England and Atlantic Coast states. This area is virtually without storage, yet it contains one-third of the nation's population. From the favorable economic picture developed in this investigation, it would seem that the application of nuclear storage in such regions, as well as in areas where conventional storage is not adequate, should be given serious consideration. (auth)

42927 PETROLEUM'S MOST DRAMATIC RECOVERY EXPERIMENT NEAR. Kinney, Gene T. Oil Gas J., 65: 71-3 (Sept. 4, 1967).

The use of underground nuclear explosions for the production of natural gas is discussed. The experiment, known as Project Gasbuggy, will utilize a 26-kt nuclear explosive detonated in gas-bearing sandstone some 4000 ft below the surface to fracture underground formations so that the entrapped gas will be released. Drilling operations for the emplacement of the nuclear explosive and monitoring and instrument holes are summarized. The feasibility and economics of using nuclear explosives to create underground gas storage cavities are also discussed. This experiment called Project Ketch, will utilize a 24-kt nuclear device detonated at a depth of 3300 ft in Devonian sandstone and shale. (R.C.K.)

42928 PEACEFUL USES OF NUCLEAR EXPLOSIVES. Nucl. News, 11: 25-9(Mar. 1968).

The industrial applications of nuclear explosives may be divided into three classes or types: scientific: The nuclear explosive has several unique characteristics that provide certain scientific research investigations not possible by other means; excavation: The nuclear explosive may be used for large-scale earth moving e.g., digging sea-level canals, stripping rock layers from deep mineral deposits, cutting highways and railway passes through mountains, creating harbors and lakes, and altering watersheds for better distribution of water resources; and contained underground nuclear engineering: Nuclear explosives can be detonated deep underground to facilitate mining ores and recovery of oil, to stimulated the flow of natural gas, or to produce underground reservoirs and permeable zones for storage of waste disposal. The use of nuclear explosives for each of these applications is discussed. (auth)

42929 NUCLEAR EXCAVATION IN WATER RESOURCES DEVELOPMENT. Biswas, Asit K. (Strathclyde Univ., Glasgow). Civil Eng. (N. Y.), 61: 1375-9(Nov. 1966).

The possible uses of nuclear excavation in water resources development programs are presented. The basic concepts of nuclear cratering are discussed. The major problems of nuclear excavation, e.g., radioactivity, air blast, and seismic effects, are discussed as they relate to the use of nuclear explosives for peaceful purposes. The feasibility of using nuclear excavations for the storage of water, ground water recharge, recreational purposes, and in building a sea-level canal is discussed. It is concluded that more research and development programs will have to be undertaken before routine commercial use of nuclear excavation becomes practical. The technical problems of using nuclear explosions can be solved. The major problem is the alleviation of fear in the minds of the public concerning any type of nuclear explosion, however safe it may be. The establishment of public confidence and acceptance would be extremely difficult. (R.C.K.)

42930 WHO SPEAKS FOR CIVIL DEFENSE. Wigner, Eugene P. (ed.). New York, Charles Scribner's Sons, 1968. 127p. $3.95.

Nuclear war and civil defense are discussed from the standpoint of the direct and indirect effects of nuclear explosions and protective measures that may be taken against them. An historical survey of civil defense in America is also presented. Information is presented that is critical of the government's handling of civil defense; on problems that must be solved for an adequate civil defense program; a survey of civil defense in other countries; and scientific aspects of the problem, not only with respect to weaponry, but also what is practicable and not practicable in the entire field. (R.C.K.)

42931 NUCLEAR WEAPONS SAFETY AND THE COMMON DEFENSE. Larus, Joel. Columbus, Ohio, Ohio State University Press., 1967. 181p. $6.50.

The problem of assuring nuclear weapons safety is discussed. One problem that grows increasingly formidable is the possibility of an accident that is either an unintentional, full-scale detonation of an atomic bomb, or alternately, a mishap that does not result in a chain reaction but occasions the release of fissionable material and the subsequent exposure of all in the inmediate area to the dangers of radioactivity. Atomic bomb design, methods of detonation, and safety are discussed. The case for internationalizing nuclear weapons safeguards is also stated. (R.C.K.)

42932 TO BUILD A BIGGER DITCH. Miller, August C. Jr. U. S. Nav. Inst., Proc., 27-34(Sept. 1967).

The feasibility of using nuclear explosions to build a new sea-level canal in Central America or Colombia connecting the Atlantic and Pacific Oceans is discussed. This canal would eliminate traffic jams in world commerce that have built up on the present Panama Canal. The need for the new canal is discussed. Political, economic, and social aspects of the venture are described. Various routes for the new canal are discussed and the economic advantages of each compared. The advantages and disadvantages of using nuclear explosives to build the canal are outlined. (R.C.K.)

Facilities and Equipment

Refer also to abstracts 42986, 42996, 43016, 43023, 44033, 44044, 44078, 44203, 44204, and 44908.

42933 (BNWL-734) WATER FILTRATION RESEARCH. PART IV. AN EVALUATION OF SELECTED POLYELECTROLYTES AS FILTER BED CONDITIONERS IN WATER TREATMENT. Olesen, D. E.; Schmidt, R. L.; Touhill, C. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1968. Contract AT(45-1)-1830. 35p. Dep. CFSTI.

This research has shown five polyelectrolytes to be as effective as those presently used as filter bed conditioners at the Hanford water treatment plants. Cost comparisons are presented for the polyelectrolytes studied. Laboratory filtration data is included for twenty-two polyelectrolytes. (auth)

42934 (IN-1155) STORAGE FACILITIES FOR RADIOACTIVE CALCINED WASTE SOLIDS AT THE IDAHO CHEMICAL PROCESSING PLANT. Bendixsen, C. L.; Lohse, G. E. (Idaho Nuclear Corp., Idaho Falls). July 1968. Contract AT(10-1)-1230. 31p. Dep. CFSTI.

A detailed description of the second facility installed for storage of radioactive calcined solids produced at the Waste Calcining Facility is presented. The major design criteria and special features such as a newly designed solids flow diverter valve, corrosion coupons of typical construction materials, a solids removal system, and thermocouples for measuring temperature gradients, are described. Costs of the two sets of storage facilities are compared. (auth)

42935 (LRP-37/68) LUMPED ELEMENT LINE GENERATORS TO PRODUCE PULSED SINUSOIDAL OSCILLATIONS IN THE GIGAWATT RANGE. Lietti, A. (Laboratoire de Recherches sur la Physique des Plasmas, Lausanne (Switzerland)). May 1968. 37p. Dep.

The present state of knowledge concerning the technique of making high-power sinusoidal pulses is reviewed and an improved line generator proposed. An analysis of wave propagation in a periodic structure together with the numerical solution of the network differential equations shows that it is possible to utilize the recurrent triggering system (hitherto applied only to homogeneous lines) with lumped element lines. A method for designing such lines is presented. Numerical tables are included and some selected examples are discussed. The theory agrees with an experiment made with a prototype line. The construction of a 720-MW, 3-MHz installation for use in plasma physics experiments is already underway. This large power is achieved by paralleling a number of lumped element line generators. (auth)

42936 (RD/B/N-1105) APPLICATION OF ELASTIC PLASTIC ANALYSIS TO THE DESIGN OF PRESSURE VESSELS. Townley, C. H. A. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). July 1968. 33p. Dep. UK.

There is an increasing interest in putting the design of pressure vessel details on a scientific basis. Rules based on elastic-plastic behavior, to ensure shakedown and to prevent excessive plastic deformation are currently finding favor. These two concepts and the evidence available to justify their adoption in practical design are discussed. For many types of pressure vessel detail, methods are now available which can provide design charts which are more rational than those in present use. The application of the general method to two specific types of detail—branch openings in cylinders and dished drum ends—are described to illustrate the method. (auth)

42937 (UCRL-50380) PROPOSED STATIONARY OR MOBILE OIL SHALE RETORTING SYSTEM. White, Elmer (California Univ., Livermore. Lawrence Radiation Lab.). Nov. 30, 1967. 39p. Dep. CFSTI.

An investigation of the minimum power required for retorting oil shale in situ using the thermal heat from a nuclear reactor revealed the necessity of having a 340 MW reactor. In order to map temperature profiles in a nuclear chimney, a new equation was derived which computes the ratio of the solid-to-fluid temperature. Heat exchangers and pumping power requirements were established for the model under consideration. The cost of the nuclear retorting system is negligible when prorated over the lifetime of the reactor. (auth)

42938 (Y-EF-170) AIR CLEANING AT THE AEC's Y-12 PLANT. Little, J. C. Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). July 31, 1968. Contract W-7405-eng-26. 30p. (CONF-680812-1). Dep. CFSTI.

From 10th AEC Air Cleaning Conference, New York.

The air-cleaning facilities used in the nuclear production operations and biological research activities at Y-12 are described, using schematic flow diagrams. The clean room facilities are also described. Problem areas are considered with emphasis on filter failures. Results of filter testing are summarized, and some problems in the mounting of high-efficiency filters are discussed. The design of a contamination control facility is discussed briefly. (D.L.C.)

42939 UNITS FOR LEAK-TIGHTNESS CONTROL USING HELIUM. ALCATEL: SERIES ASM-4. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.), No. 70, 38-44(Mar.-Apr. 1968). (In French).

A helium leak detector unit, the ASM-4, was constructed in base modules. It is basically a series of controlled posts that can be adapted to any case of leak control. The base module is described in detail and its general and technical characteristics are given. Four different versions of the ASM-4 are given and their areas of application indicated. (J.S.R.)

42940 REMOTE POWER MANIPULATORS. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.), No. 70, 45-8(Mar.-Apr. 1968). (In French).

Light and medium duty remote control devices are briefly described as an introduction to the description of powered remote control manipulators. (J.S.R.)

42941 IMPROVED FLUIDIZED-BED CONTACTOR AND METHOD THEREOF. (to United States Atomic Energy Commission). British Patent 1,120,003. July 17, 1968. Priority date June 11, 1965, United States.

A gas-solid contactor includes a housing defining a plenum and an apertured face plate forming one end of the housing. The face plate is substantially cone shaped and has an included angle of between 100 and 150°. A reaction chamber holding a columnar bed of discrete solid particles joins the periphery of the face plate. The upper section of the reaction chamber is substantially cylindrical while the lower portion that joins the face plate is inwardly tapered. A gas manifold is mounted in the plenum opposite the face plate. A central gas passageway connected with the corresponding centrally mounted apertures in the face plate extends through the manifold and provides means for passing a continuous stream of gas from a first gas inlet upwardly through the central gas passageway and outwardly through the central aperture in the face plate. A number of gas passageways connect the manifold with corresponding peripheral apertures in the face plate. A continuous stream of gas is passed from a second gas inlet upwardly through the manifold to pass through a number of passageways and outwardly through corresponding apertures in the face plate. (B.L.M.)

42942 SPINDLE ACCURACY MEASURING EQUIPMENT (Engineering Materials). (California Univ., Livermore. Lawrence Radiation Lab.). (CAPE-1736).

21 drawings.

Equipment is described which is used to measure high-speed spindle performance for a numerically controlled lathe at speeds up to 2000 rpm. The equipment provides a direct measure of the peak-to-valley surface finish achieved with a round nose diamond tool, cutting without buildup. A synchronized polar recording system is employed. Radial, angular, axial, structural, and face spindle motion are displayed on the polar recording system. The equipment consists of a displacement detector, amplifier for a proximity detector, Hall effect multipliers, and a polar display system. (For details see TID-4100 Suppl. 47) (F.S.)

42943 EXPERIENCES WITH AIRTECHNICAL SYSTEM OF THE LABORATORY FOR MANUFACTURING ISOTOPES IN HUNGARY. Hirling, Jozsef; Golder, Ferenc. Energ. Atomtech., 20: 555-64(Nov.-Dec. 1967). (In Hungarian).

In the manufacture and application of radioactive materials, the human organism can be damaged by inhalation of radioactive gases and dispersed aerosols in the air. Damage to the healthy can be caused by an extremely slight concentration of radioactive aerosols. For its prevention, particular tasks of air filtration techniques must be solved, for which the experience of the laboratory for manufacturing isotopes in Hungary can be useful. In this study, the dimensioning method for the ventilation system, air filtration, and of the dilution of the air being exhausted into the surroundings as well as the service experience based on measurements are discussed in detail. (auth)

42944 IMPROVEMENTS IN OR RELATING TO FISSION PRODUCT TRAPPING SYSTEMS. Taylor, Roland (to United Kingdom Atomic Energy Authority). British Patent 1,123,821. Aug. 14, 1968. Filed Jan. 22, 1965.

A fission product trapping system is designed for removing methyl iodide from a vapor of high relative humidity, such as in a reactor. The system includes activated charcoal impregnated with a water-soluble secondary or tertiary amine (such as morpholine, piperidine, piperazine, or triethylenediamine). Data are given on the extent of penetration of the impregnated charcoal by labeled methyl iodide from air—CO_2 mixtures at ~100% relative humidity. The effects of contact time, loading, and % impregnation on the penetration are shown. A method for impregnating the charcoal is given. (See British Patent 1,123,822 for another form of the invention). (D.L.C.)

42945 IMPREGNATED ACTIVATED CHARCOAL. Taylor, Roland (to United Kingdom Atomic Energy Authority). British Patent 1,123,822. Aug. 14, 1968. Filed Mar. 30, 1965.

A charcoal is described for use in a fission product trapping system (see British Patent 1,123,821) for removing methyl iodide from wet gases. The charcoal is impregnated with piperazine or triethylenediamine. Results are given of experiments on the penetration of the impregnated charcoals by methyl iodide-131 from wet air—CO_2 mixtures. The effects of % impregnation on the penetration are shown. (D.L.C.)

42946 WEDGE GATE VACUUM VALVE MECHANISM WITH COATED SEAT SEAL. Batzer, Thomas H.; Gunderson, C. A.; Murphy, J. J. (to United States Atomic Energy Commission). U. S. Patent 3,397,862. Aug. 20, 1968.

A vacuum gate valve for sealing a port of large cross-sectional area in an ultrahigh vacuum system is described. A flat, circular seat surface surrounding the port is coated with a thin film of polymerized tetrafluoroethylene. A valve gate closure plate has an integral sealing surface which is annularly inclined toward the center of the gate. Upon forcing together the mating sealing sections by a large, centrally applied loading force upon the closure plate, the plate becomes deformed thereby producing a substantially flat, high integrity hermetic seal between valve gate and seat. (AEC)

42947 MECHANISM OF CARBURIZATION OF STAINLESS STEEL IN SODIUM AS IDENTIFIED BY A NEW CARBON METER. Kolodney, M. (City Coll., New York). Nucl. Eng. Design, 7: 481-4(May 1968).

Sodium, which is proposed as a coolant for fast breeders, may carburize or decarburize steels employed as cladding or structural materials. Until recently, it has not been possible to characterize the carburizing potential of the sodium, but a new continuous meter appears capable of measuring the thermodynamic activity of carbon in sodium. This device employs an iron septum as a sensing element and translates the flux of carbon through the iron into a measure of carbon activity in the sodium. The meter has been used to demonstrate that the early stages of the carburization of an austenitic stainless steel proceed by a precipitation mechanism. (auth)

42948 HEAT EXCHANGER CALCULATION ON DIGITAL COMPUTER. Dvetkovic, Dragan; Lekic, Alija; Dzubur, Ibro; Bajramovic, Rasim; Vuletic, Veljko (Energoinvest, Sarajevo, Yugoslovia). Tehnika (Belgrade), 23: 369-73(1968). (In Slovak).

The application of digital computers for calculating and dimension determination of water-steam heat exchangers is presented. A review of the equations of thermodynamic properties of water and steam was made and on the basis of analysis, the most suitable equations were selected. Determination of dimensions of heat exchanger was based upon subprograms for calculation of the area and standard elements. The calculations supplied, in addition to detailed dimensions and specification of materials, the weight of elements and total weight of exchanger. Programs also enabled the determination of optimum exchangers. (auth)

42949 TELETHERAPY MACHINE AND INSTALLATION THEREFOR. Henschke, Ulrich K. British Patent 1,117,914. June 26, 1968. Priority date Nov. 30, 1964, United States.

An irradiation facility which comprises two treatment rooms sharing a central wall, a teletherapy machine extending through this wall, and a means for moving the radiation source of the machine into each room is described. (B.G.D.)

42950 HIGH TEMPERATURE OVEN. Donaldson, Ronald; Elson, Albert Walter (to United Kingdom Atomic Energy Authority). British Patent 1,121,596. July 13, 1968. Filed June 24, 1966.

A sealed high-temperature oven for sintering nuclear fuel pellets of Pu or U compounds has a refractory tunnel intercommunicating two glove boxes, a number of loose refractory boats to convey the material through the furnace, a sealed motor driven push-rod, and transfer devices for loading or unloading the boats through glove boxes. Empty boats are returned through a second tunnel upon a manually operated conveyor belt. Vertical heating units are replaced by means of a hoist located in the glove box. An atmosphere of H_2 and/or A is provided. (P.G.C.)

42951 IMPROVEMENTS IN ELECTRIC RESISTANCE FURNACES. (to Australian Atomic Energy Commission). British Patent 1,123,606. Aug. 14, 1968. Priority date Sept. 3, 1965, Australia.

A high-temperature electric resistance furnace comprises a squirrel-cage assembly of graphite rods in which the intermediate portion provides the heating zone. The rods are electrically connected in series by graphite bridging elements and graphite nuts. Alternately the rods may be supported in stabilized zirconia rings, for operation above 1800°C, or by alumina rings for lower temperatures. Configuration of the rods may be varied so that the intermediate portion has higher electrical resistance than other segments. The assembly of heating elements is contained in a conventional shell using reflectors and insulating material. (P.G.C.)

42952 EXPLOSIVE WELDING. Australas. Mfr., 30-3 (July 1, 1967).

Explosive welding is discussed under the following topics: mechanism of welding; variables in explosive welding; angle of incidence; varying velocity of flyer plate; properties of metals; welding using interlayers; materials joined; and limitations, advantages, and applications. Explosive welding is applicable to the fabrication of tubular transition joints between ferrous and nickel-base alloys and Zircaloy used in nuclear reactors. (R.C.K.)

42953 ESTIMATION OF THE SIZE DISTRIBUTION OF URANIUM OXIDE PARTICLES BY ALPHA-RAY SPECTROMETRY. Fujita, Akira; Matsunami, Tadao; Mamuro, Tetsuo. Annu. Rep. Radiat. Center Osaka Prefect., 8: 37-9(1967).

The possibility of estimating the size distribution of uranium oxide particles by α-ray spectrometry was investigated. Alpha-ray spectrometrical measurements were made of several samples of uranium oxide particles of different sizes which were prepared by the sedimentation method. It was found that rough estimation of the size distribution of uranium oxide particles is possible for the particles in a size range of $0.5 \sim 10\ \mu$ in diameter by measuring the shift of the peak position and the broadening of the peak width. (auth)

42954 OUTLINE OF THE HARBOR FOR THE FIRST NUCLEAR-POWERED SHIP. Ikemura, Kiyoshi. Fune no Kagaku, 20: 91-4; 107(Dec. 1967). (In Japanese).

The first nuclear-powered ship constructed by the Japanese has a total weight of about 8,300 tons, and a PWR with a heat output of 36,000 kW. The harbor for this nuclear-powered ship is at Ominato Port in Aomori Prefecture. Geographical features and functions and facilities of the harbor, fuel exchange, waste disposal, and safety of the harbor are discussed. The harbor is expected to be used for subsequent similar ships. (NSA of Japan)

42955 ELECTRO-MAGNETIC PUMP. Mead, George Nathaniel Jackson. British Patent 1,114,979. May 22, 1968. Filed Aug. 13, 1964.

A description of an electromagnetic pump comprising a conduit having fixed coils wound about its outer surface with adjacent coils arranged in opposite polarity is given. Mounted within the conduit are at least two interleaved, electrically insulated spiral baffles with the outer ends of the baffles attached to the inner wall of the conduit at spaced points of connection to define two separate spiral passages between the conduit wall and a conductive rod extending axially along the conduit. Two strip electrodes of opposite polarity are mounted on the conduit wall, one at the outer end of each spiral passage. Sections of each electrode are alternately exposed and insulated whereby an applied electric current will spiral inwardly to the central conductor in one section of the conduit, advance axially along the conductor, and then spiral outwardly in an adjacent section of the conduit, thus producing fluid electro-magnets having magnetic fields that are opposed to each other. Only one of the two spiral passages in each section is used at one time. The fields set up by the fluid solenoids co-act with fields formed by fixed windings on the conduit causing the fluid within the conduit to be pumped axially along the conduit. (J.C.W.)

42956 PROTECTIVE SHIELD STRUCTURE. (to National Lead Co.). British Patent 1,120,397. July 17, 1968. Priority date Nov. 6, 1964, United States.

A fire shield structure is designed for use with radioactive material shipping containers. The shield protects from fire while permitting the discharge of decay heat. The shield comprises a hollow body which is placed over the container with a space between. The hollow body includes heat insulating wall portions for shielding against external heat sources, air inlet and outlet means for circulating air into the shield interior and about the container, and air flow control means for stopping the air circulation at a predetermined temperature. Several embodiments of the invention are described. (D.L.C.)

Heat Transfer and Fluid Flow

Refer also to abstracts 42871, 42948, 43533, 43972, 43975, and 43978.

42957 (AHSB(S)R-147) CONDUCTION CONTROLLED FLASHING OF A FLUID, AND THE PREDICTION OF CRITICAL FLOW RATES IN A ONE DIMENSIONAL SYSTEM. Edwards, A. R. (United Kingdom Atomic Energy Authority, Risley (England). Authority Health and Safety Branch). 1968. 57p. Dep.

The prediction of critical flows from large diameter pipes, which in reactor situations tend to have low L/D values, is very uncertain. The assumption that the same discharge rate per unit area is obtained for equal L/D ratios is generally used. A theory and calculation method, based on the concept of bubble growth being controlled by heat conduction through the surrounding liquid layer, is developed. Correlations for coefficients controlling the number of bubbles present and the time delay in their formation are deduced from experimental work on small diameter ($\frac{1}{4}$ in.) pipes with L/D less than 20; these are then used in the prediction of the critical discharge of larger diameter pipes. The theory may be used for subcooled, saturated, or low quality two-phase entry flows, with sharp-edged or radiused entries. The discharge rates predicted by this theory are much lower than those obtained by the use of L/D scaling, in some cases by as much as 50 percent. (auth) (UK)

42958 (CONF-680903-1) FILM THICKNESS AND CRITICAL HEAT FLUX OBSERVATIONS FOR HIGH PRESSURE WATER IN SPRAY ANNULAR FLOW. Bergles, A. E.; Roos, J. P. (Dynatech Corp., Cambridge, Mass.). [1968]. Contract AT(30-1)-3304. 39p. Dep. CFSTI.

From International Symposium on Research in Cocurrent Gas-Liquid Flow, Waterloo, Ontario.

Film thickness measurements are reported for steam-water mixtures flowing in circular tubes and a rod bundle at 1000 psia. A traversing electrical probe of the needle-contact type was developed for these measurements. Adiabatic films are shown to be thicker than predicted by available models, due to entrained vapor. By observing the film behavior, it was possible to adjust an annular mixer so as to avoid irregular film behavior. With the exception of very high mass velocities, the film thickness for both subcooled and mixed inlet conditions proceeds smoothly to zero as the critical heat flux condition is approached. For similar local flow conditions, thicker films are observed away from dryout in 0.8 in. tubes than in 0.4 in. tubes; however, critical heat fluxes are higher for 0.4 in. tubes. Wide variations in film thickness are observed in various subchannels of the rod bundle. (auth)

42959 (EURAEC-2025) A THEORETICAL ANALYSIS OF SOME MODELS FOR STEADY BURNOUT. Final Report. Biasi, L.; Clerici, G. C.; Sala, R.; Garribba, S.; Tozzi, A. (Applicazioni e Ricerche Scientifiche, Milan (Italy)). [1966]. Contract 106-66-12-TEEI. 166p. (EUR-3800). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

A study of the heat transfer crisis in circular ducts with positive quality at the outlet is described. Two approaches were followed in the work: the first was a theoretical study on liquid film flowrate under heat transfer conditions, with the aim of predicting film dryout; the second was an examination of experimental burnout data with the goal of correlating them by means of a simple analytical expression. The principal characteristics of an adiabatic model are briefly summarized. A kinetic equation, relating the film flowrate to the departure from equilibrium, is derived. The equation is applied to predict the critical heat fluxes leading to dryout at the duct outlet for given inlet conditions (mass flowrate, quality, pressure, and duct radius). The results obtained are compared with the corresponding experimental burnout data for uniform heating and hot patch, assuming equilibrium inlet conditions. (R.C.K.)

42960 (GEAP-5563) TRANSITION BOILING HEAT TRANSFER PROGRAM. Final Summary Report on Program for February 1963-October 1967. Polomik, E. E. (General Electric Co., Schenectady, N. Y. Atomic Power Equipment Dept.). Oct. 1967. Contract AT(04-3)-189. 109p. (EURAEC-1957). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

Heat transfer data and high-speed motion pictures were obtained for water at critical heat flux, throughout the transition boiling range, and in film boiling. Data were obtained with smooth and specially roughened surfaces with one-, two-, and three-rod heaters. Most of the heat transfer data with single-rod heaters were obtained with annular flow and the inner boundary heated. The balance of single-rod heater data were obtained with flow inside heated tubes for the purpose of measuring bulk mean superheated steam temperatures. The test parameters in general were in the ranges: 600 to 1400 psia pressure, 0.25×10^6 to 2.0×10^6 lb hr-ft^2 mass velocity, and 20 to 100 wt % steam quality. Analytical results were obtained for temperature oscillations at the inner wall of a tube with uniform heat generation in the wall and external cooling. A typical nuclear fuel rod was analyzed for temperature oscillations at the external cladding surface. The detailed results and conclusions are summarized together with a brief description of the test equipment. (auth)

42961 (KAPL-M-6532(Add.)) LION. Binney, E. J. (Knolls Atomic Power Lab., Schenectady, N. Y.). June 28, 1968. Contract W-31-109-Eng-52. 40p.

LION is a digital computer program for the solution of three-dimensional transient and steady-state temperature distribution problems. An addendum to the program is presented to summarize the modifications made to the code and to update the LION report through June 28, 1968. The changes made include the following: dynamic storage allocation specifiable by the user; extra node feature for modelling flexibility; acceleration factor feature to assist in steady-state solutions; temperature dependent conductivity and specific heat option; allowance for a third material in the internal connections; provision for inputting saturation temperature; increase in the limits for various input parameters; and format modifications to make the output more readable and more useful. A revised input description is also included. (R.C.K.)

42962 (NYO-3679-4) HEAT TRANSFER AND HYDRAULICS. THE EFFECTS OF SUBCOOLED VOIDS. Fourth Quarterly Report, January-March 1968. Staub, F. W.; Walmet, G.; Niemi, R. O. (General Electric Co., Schenectady, N. Y. Research and Development Center). Apr. 1968. Contract AT(30-1)-3679. 77p. (EURAEC-2013). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

An experimental and analytical program directed toward the determination of the void distribution, location of the initiation of net vapor generation, pressure drop, and heat transfer coefficients in subcooled boiling water systems is discussed. The measurement of the initiation and early development of the subcooled void profile, including all required profile measurements and observations, with low pressure water is described. Void profiles, pressure drop and heat transfer coefficients will be measured at a reduced pressure of about 0.4 to 0.5 in water. All water experiments will be conducted with and without a reactivity and a ph control additive to determine their effect at both low and high pressures. The objectives of the analytical effort were to derive general equations which accurately predict the void fraction, pressure drop, and heat transfer coefficients in two-phase flow with subcooled boiling for various fluids and over a wide range of operating conditions. Emphasis will be placed on the formulation of the point where net vapor generation is initiated, in subcooled boiling, in terms of the surface and fluid properties, local geometry, and the operating characteristics of the system. (auth)

42963 (NYO-3679-5) HEAT TRANSFER AND HYDRAULICS. THE EFFECTS OF SUBCOOLED VOIDS. Fifth Quarterly Report, April-June 1968. Staub, F. W.; Walmet, G.; Niemi, R. O. (General Electric Co., Schenectady, N. Y. Research and Development Center). June 1968. Contract AT(30-1)-3679. 96p. (EURAEC-2052). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

An experimental and analytical program directed toward the determination of the void distribution, location of the initiation of net vapor generation, pressure drop, and heat transfer coefficients in subcooled boiling water systems is discussed. The measurement of the initiation and early development of the subcooled void profile was carried out, including all required profile measurements and observations, with low pressure water. The void profile and the pressure drop and heat transfer measurements will be extended to a reduced pressure range of 0.1 to 0.7 and the higher quality regions, using the Refrigerant-22 facility. The void profiles, pressure drop and heat transfer coefficients will be measured at a reduced pressure of about 0.4 to 0.5 in water. All water experiments will be conducted with and without a reactivity and a pH control additive to determine their effect at both low and high pressures. The objectives of the analytical effort are to derive general equations which accurately predict the void fraction, pressure drop, and heat transfer coefficients in two-phase flow with subcooled boiling for various fluids and over a wide range of operating condition. Emphasis is placed on the formulation of the point where net vapor generation is initiated, in subcooled boiling, in terms of the surface and fluid properties, local geometry, and the operating characteristics of the system. (auth)

42964 (ORNL-tr-1914) THEORETICAL INVESTIGATION OF CELLULAR CONVECTION CURRENTS. Zierep, J. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Fluid Dynamic Transactions. Proceedings of the 5th Symposium, Poland, 1961, 2: 343-57(1965). 16p. Dep. CFSTI.

The Bénard cellular convection currents (formation of cells with self-contained vortex circulation when a horizontal layer of liquid is heated) are described, and some similarities with natural flow processes are pointed out. The linear theory developed for such cellular convection currents is outlined, and the reason for the preference of the hexagonal cell form is explored. Nonpolygonal cell shapes, direction of movement, overheating above critical temperature, uneven heating, and effects of vessel walls are considered. (D.L.C.)

42965 (WANL-TME-1753) THERMODYNAMIC AND TRANSPORT PROPERTIES OF HELIUM AND NITROGEN. Pierce, B. L. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). May 1968. Subcontract NP-1. 79p. Dep. CFSTI.

Digital computer programs coded in FORTRAN IV language that are used to calculate the thermodynamic and transport properties of molecular helium and nitrogen are described. The programs are oriented toward heat transfer and fluid flow calculations. The results of property calculations cover the pressure range from 1 to 2500 psia and temperature ranges of 35 to 4500°R for helium and 120 to 4500°R for nitrogen. Instructions for the use of the programs are provided and a tabulation of property values is included. (auth)

42966 EFFECT OF NUCLEAR RADIATION ON THE SUPERHEATED LIQUID STATE. Becker, Allan Gene. Detroit, Wayne State Univ., 1963. 103p.

Thesis.

The resistance to boiling of superheated diethyl ether under gamma ray and neutron irradiation has been measured, and these measurements are compared with the two known theories of bubble nucleation in an ionizing radiation field. The measurements consisted of obtaining the statistical time distributions in which the superheated liquid state will remain stable in the presence of various radiation fields. The probability of a single ionizing particle destroying a given superheated state could then be calculated from these measurements. The results of these studies show that the two prevailing theories of bubble nucleation are incorrect. The effects of various modifications of these theories are discussed, and it is concluded that a new theoretical approach is necessary for a fuller understanding of the nucleation phenomena. Suggestions of the possible direction such a new approach might take are given. (Disser. Abstr.)

42967 DEPENDENCE OF DROPWISE CONDENSATION HEAT TRANSFER COEFFICIENT ON TEMPERATURE. Ivanovskii, M. N.; Milovanov, Yu. V.; Subbotin, V. I. At. Energ. (USSR), 24: 523-9(June 1968). (In Russian).

Measurement of heat transfer coefficients for dropwise condensation of mercury vapor was carried out. It was found that in the range of vapor pressures with insignificant thermal resistance of the phase transition, the heat transfer coefficient for dropwise condensation of stationary vapor does not practically depend on the temperature if the latter is not very small. It was shown that the decrease in the heat transfer coefficient while increasing the temperature, discovered in earlier studies on mercury dropwise condensation, is due to the influence of non-condensable gas diffusion resistance. In those cases when the vapor velocity constituent parallel to the wall is significant the vapor flow acts dynamically upon the drops changing their mean size. The stronger the action the greater the temperature. As a rule the mean drop size decreases resulting in a heat transfer coefficient increase with increase of the temperature. A formula is given which expresses the relationship between the coefficient and the mean drop size, the condensate thermal conductivity, the ratio of summary drop surface to the wall surface, and the thermal resistance of the phase transition at the vapor-drop boundary. (auth)

42968 IMPROVEMENTS IN OR RELATING TO HEAT EXCHANGERS. (to Babcock and Wilcox Ltd.). British Patent 1,118,679. July 3, 1968. Priority date Jan. 28, 1965, Germany.

The design of a heat exchanger is described, having tubes for the two heat exchanging fluids flowing parallel to one another, one tube contained within the other. The inner tube is jointless and the outer tube is formed in sections welded end to end along the inner tube. (J.C.W.)

42969 IMPROVEMENTS IN OR RELATING TO HEAT EXCHANGERS. Hartley, Donald Edward. British Patent 1,117,891. June 26, 1968. Filed July 9, 1964.

The design of a heat exchanger to promote increased rates of heat transfer is described. The design provides for good fluid mixing with only small increases in the pressure drops. The fluid will be mixed without creating wakes or pockets if the fluid particles describe helical paths with the axes of the helices parallel to the heat transfer surface and to the flow direction. (J.C.W.)

Isotope Technology

Refer also to abstracts 42858, 42917, 42918, 43141, 43351, and 44212.

42970 (ALO-3634-9) RESEARCH AND DEVELOPMENT OF VACUUM FOIL-TYPE INSULATION FOR RADIOISOTOPE POWER SYSTEMS. Quarterly Progress Report, March 1968–May 1968. Carvalho, J.; Dunlay, J. B.; Fronduto, J.; Paquin, M. L.; Poirier, V. L. (Thermo Electron Corp., Waltham, Mass.). July 26, 1968. Contract AT(30-1)-3634. 68p. Dep. CFSTI.

Progress is reported on the development of high-temperature thermal insulation for radioisotope power systems. A new planar heat transfer test apparatus has been fabricated and is now in use. To date, twenty planar insulation samples have been fabricated and tested. These tests indicate that for a given particle size, the optimum oxide coating is the minimum amount consistent with complete foil separation. The performance of a planar insulation sample subjected to compressive stresses up to 5.11 psi is also presented. The operating characteristics of a modified cylindrical heat transfer apparatus are discussed. The low temperature material compatibility tests have been completed and a low temperature heat transfer apparatus has been designed and fabricated. (auth)

42971 (DP-1145) EXPERIMENTAL ^{60}Co HEAT SOURCE CAPSULES. Faraci, J. P. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). May 1968. Contract AT(07-2)-1. 19p. Dep. CFSTI.

Cobalt containing up to 280 curies of ^{60}Co per gram of metal was encapsulated in nickel- and cobalt-based superalloys. These experimental heat source capsules, producing up to 660 watts each, were prepared for testing at 850 to 1000°C for up to 10,000 hours. (auth)

42972 (K-Trans-37) BASIC RESEARCH ON GASEOUS DIFFUSION SEPARATIONS. Higashi, Kunio. Translated for Union Carbide Corp., Nuclear Div., Oak Ridge, Tenn., from a Japanese Thesis. 116p. Dep. CFSTI.

Studies of the basic aspects of gaseous diffusion separation are discussed. Topics covered include: previous theoretical treatment of gaseous diffusion separation, mechanisms of surface diffusion, separation of a two-component gas with surface diffusion, separation of isotopes by surface diffusion flow, isotope effects on surface diffusion flow, method of selecting optimum operating conditions for gaseous diffusion separation equipment, and flow pattern of gases in gaseous diffusion separation. (M.C.G.)

42973 (MMM-3691-35) SNAP-21 PROGRAM, PHASE II. DEEP SEA RADIOISOTOPE-FUELED THERMOELECTRIC GENERATOR POWER SUPPLY SYSTEM. Quarterly Report No. 8, April 1, 1968–June 30, 1968. (Minnesota Mining and Mfg. Co., St. Paul. Electrical Products Group). June 1968. Contract AT(30-1)-3691. 317p. Dep. CFSTI.

SYSTEMS FOR NUCLEAR AUXILIARY POWER (SNAP-21)—power supply system for, design and testing of
SHIELDING—testing of biological, for SNAP-21
THERMAL INSULATION—development and testing of SNAP-21
THERMOELECTRIC CELLS—components for SNAP-21, performance testing of
THERMOCOUPLER—development and testing of, for SNAP-21 thermoelectric generator
PRESSURE VESSELS—design and testing of SNAP-21
SHIPPING—container for SNAP-21, design, fabrication and testing of
STRESS—analysis of SNAP-21 shipping container
THERMOELECTRIC CELLS—shock and vibration testing of SNAP-21

42974 (ORNL-TM-2223(Pt.2)) SELECTED ABSTRACTS OF NON-U. S. LITERATURE ON PRODUCTION AND INDUSTRIAL USES OF RADIOISOTOPES (FROM NSA, APRIL–JUNE 1968). Gerrard, Martha; Baker, P. S. (Oak Ridge National Lab., Tenn.). Aug. 1968. Contract W-7405-eng-26. 37p. Dep. CFSTI.

More than 400 abstracts of non-U.S. publications on production and use of radioisotopes and radiation, selected from the April–June 1968 issues of Nuclear Science Abstracts, are presented. (auth)

42975 (ORNL-tr-1805) USE OF RADIOELEMENTS IN SEDIMENTOLOGY. Courtois, Guy. Translated by Martha Gerrard (Oak Ridge National Lab., Tenn.), from pp 117-65 of Isotopes in Hydrology. Symposium held in Vienna, 14–18 November 1966, International Atomic Energy Agency, Vienna, 1967. 84p. Dep. CFSTI.

A list of 263 references on the use of radioisotopes in sedimentology published up until the end of 1966 is presented. Potentialities, trends, and possible improvements of methods in the use of radioisotopes in this field are presented. The text deals specifically with (1) radioisotope tracer study of sea and river sediments, (2) continuous absorptiometric measurement of suspended- or deposited-sediment densities, and (3) miscellaneous applications including dating, composition analysis, and soil erosion study. Future possibilities are discussed. (auth)

42976 (SC-DC-68-2161) EFFECTS OF THE REENTRY ENVIRONMENT ON RADIOISOTOPE HEAT SOURCES. McAlees, S. Jr. (Sandia Corp., Albuquerque, N. Mex.). July 1968. Contract AT(29-1)-789. 27p. (CONF-681002-1). Dep. CFSTI.

From Nuclear Metallurgical Symposium on Materials for Radioisotope Heat Sources, Gatlinburg, Tenn.

The reentry environment for space nuclear systems can be separated into three classes, based upon (1) malfunction of the launch vehicle prior to achieving orbit, (2) orbital decay from a short-lived non-nominal orbit resulting from launch vehicle malfunction during the orbital insertion phase of the mission, and (3) malfunctions of the launch vehicle which result in earth atmospheric entry for lunar or planetary missions. The range of initial velocities and reentry angles is defined for each of the three classes of aborts. The initial reentry conditions, along with the spacecraft configuration resulting from the abort, define the reentry environment to which the nuclear system is exposed. The theoretical and experimental program to define the reentry environment and its effect on the nuclear system is defined and discussed. Materials and design concepts selected to provide intact reentry for a particular SNAP system are described, and results of current studies to predict the response of this system to the reentry environment are presented. (auth)

42977 (SC-PR-68-451) AEROSPACE NUCLEAR SAFETY PROGRAM. Sandia Laboratories Quarterly Report, April 1–June 30, 1968. Illing, R. G. (comp.) (Sandia Corp., Albuquerque, N. Mex. Aerospace Nuclear Safety Information Center). July 1968. 69p. Dep. CFSTI.

Descriptions of research, development, support, and test activities associated with Snap-19, Snap-27, Snap-29, and NAVSAT are presented. Activities associated with advanced fuel safety are reported along with research progress on intact heat sources and investigations of radiation doses from $^{238}PuO_2$ and ^{210}Po. Information is also included on computer code development. (J.R.D.)

42978 (SC-RR-68-351) DESIGN OF SPACE NUCLEAR POWER SUPPLIES FOR INTACT REENTRY. Klett, R. D. (Sandia Corp., Albuquerque, N. Mex.). May 1968. 34p. Dep. CFSTI.

It was found that it is safer to contain some fuel forms throughout reentry rather than attempt to disperse the fuel at high altitudes. The environments that intact nuclear power supplies are exposed to are discussed. The requirements each environment places on the design are covered, and basic design concepts are suggested. Parametric time-saving methods are presented for analysis of some early phases of power supply thermal design. (auth)

42979 SOURCE NUCLEAR FISSION PRODUCTS. (to Rensselaer Polytechnic Inst.). French Patent 1,183,719. Filed Aug. 13, 1957.

A fission product radiation source is described which comprises a fibrous mineral containing as its essential ingredient an isotope that is either fissionable by thermal neutrons or convertible by thermal neutrons to a fissionable isotope. The fibrous mineral preferably comprises fibrous glass, having a fiber diameter of less than 10 μ, and containing ^{235}U, ^{233}U, ^{239}Pu, or a uranium oxide such as U_3O_8 enriched in ^{235}U. Suitable glass compositions are included in the following ranges of concentrations by weight: SiO_2 40 to 50%, Al_2O_3 5 to 12%, TiO_2 10 to 20%, ZrO_2 2 to 7%, Na_2O 15 to 25%, and U_3O_8 10% being enriched with at least 90% ^{235}U. (NPO)

42980 TOHOKU UNIVERSITY ISOTOPE SEPARATOR. Goto, Hidehiro; Suzuki, Shin (Tohoku Univ., Sendai). Shitsuryo Bunseki, 16: No. 1, 1-15(Mar. 1968). (In Japanese).

The general aspect of the isotope separator, installed in The Research Institute for Iron, Steel, and Other Metals, Tohoku University, is described. Several operational characteristics as well as the working conditions for the isotope separation of both Mg and Fe are presented. In the separation of Fe isotopes, content of Fe^+ ion in the ion beam increased with increasing flow rate of Ar gas into ion source where $FeCl_2$ was charged as original materials. This phenomenon is advantageous for improving the yield of Fe isotopes. The total efficiency was 0.15% for ^{25}Mg and 0.7% for ^{54}Fe. (NSA of Japan)

42981 ELECTRODIALYTICAL PRECIPITATION OF ^{58}Co IN THE FORM OF SULPHIDE ON ANIONITE MEMBRANES. Roemer, J.; Ross, R. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Isotopenpraxis, 4: 175-8(May 1968). (In German).

The electrodialytical production of beta-sources with precipitation of sulphides is described. Cobalt-58 was used as the tracer. The influence of time, current density, concentration of acid, volume of anolyte on the yield was investigated. Other cations disturb the deposition. (auth)

42982 SEPARATION OF URANIUM ISOTOPES IN A 10-STAGE SEPARATION NOZZLE PILOT PLANT. Becker, E. W.; Frey, G.; Schuette, R.; Seidel, D. (Univ., Karlsruhe, Ger. Kernforschungszentrum, Karlsruhe, Ger.). Atomwirt., Atomtech., 13: 359-62(July 1968). (In German).

A process was developed for enrichment of ^{235}U that depends on the partial spatial separation of various heavy components in a supersonic flow over curved paths. The method, known as the separation nozzle process, avoids the microporous membranes of of the diffusion process and the mechanically highly stressed parts of the centrifugal process. The elementary separation effect must be reinforced by use of a series of separation elements connected in cascade. A precise knowledge of the stability of gas dynamics and control characteristics of such a cascade is required in order to assess the industrial prospects of the process. For this purpose a 10-stage separation nozzle experimental plant for separation of uranium isotopes was built. Its construction and commissioning are described. A mixture of UF_6 and helium is fed through a curved Laval nozzle. It consists of a deflecting partition and a full cylinder which is mounted excentrically to it. The gas mixture expands in the nozzle. A knife edge, known as the "peeler," is mounted at the place where the gas stream leaves the deflecting partition. The flow is split up by the peeler into light and heavy fractions. The 10 stages of the separation nozzle cascade were installed together with the compressors in a single room. From the beginning it has worked in a stable manner. Experiments carried out indicate that no serious control problems are likely to arise with a technical realization of the separation nozzle process. (auth)

42983 FILTRATION OF SURFACE WATER AND MOVEMENT UNDERGROUND WATER IN ARID ZONES. Tamers, Murray A. (Instituto Venezolano de Investigaciones Cientificas, Caracas). Acta Cient. Venez., 18: Suppl. 3, 358-71(1967). (In Spanish).

Natural radiocarbon was used to investigate the movement of water in the aquifers of Barquisimeto, Maracaibo, Coro, Paraguana, and Valencia in Venezuela. Radiocarbon dating of the carbonate species present in groundwater furnishes information on the recharge of underground deposits as well as the direction and rate of movement. The origin of the dissolved carbonates is 2-fold: modern carbon is provided by carbon dioxide from the atmosphere and the products of plants in the soil, and ancient carbon from dissolving limestone. The latter source is essentially free of radiocarbon and, therefore, causes falsely odd dates for total groundwater carbonates. Estimation of the amount of limestone dilution is the main difficulty in radiocarbon dating of groundwater. Methods are proposed for this correction and applied to aquifers under different conditions. Numerous measurements showed that the use of naturally occurring ^{13}C may result in important uncertainties. Adjustment of the dates for the limestone contribution employing bicarbonate and total carbon concentrations is considerably more successful and gave reasonable results. For the aquifers examined, ages ranging from modern to 35,000 yr were obtained. In general, older dates correlated well with arid climatic conditions. Infiltrations from rivers and lakes were also studied in wells surrounding the surface-water bodies. Radiocarbon ages of various groundwaters, after correction for limestone, were in agreement with the expected situations as deduced from considerations of climatic conditions of the different regions. (BBB)

42984 DETERMINATION OF SELF-ABSORPTION IN ^{204}Tl SOURCES. Denisikov, A. I.; Sobolev, Yu. P. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr., No. 2, 152-4(1965). (In Russian).

Self-absorption was measured in ^{204}Tl sources. The magnitude of the self-absorption was determined by comparing the activities of the investigated sources with the activity of a "weightless" source. To prepare the sources, a solution of metallic ^{204}Tl in 0.5$\underline{N}$ HNO_3 was used. The amount of salt in the solution was 20 $\mu g/\mu Ci$. The substrates used were organic films ~30 $\mu g/cm^2$ thick, prepared from vinyl perchloride resin coated with a layer of gold to make it conducting. The "weightless" sources were prepared by a method of electrocapillary sputtering. To determine the activity of the "weightless" sources, a proportional 4π β-counter was used (with allowance of absorption in the substrate). The electron capture in ^{204}Tl was assumed to be 2%. Comparison of the activities of the investigated sources with the activity of the "weightless" source was with the aid of an end-window counter of the T-25-BFL type. The distance between the source and the counter window was 15 mm. From the plot presented it follows that the maximum near which the counting rate is proportional to the activity, occurs at ~5 mg/cm^2, irrespective of the thickness of the substrate and of the active layer of the source. The method described was used to determine also the coefficient of back scattering of β radiation of ^{204}Tl from an aluminum substrate. The value of the back-scattering coefficient was 0.395 ± 0.01, in agreement with available published data. (ATD)

42985 ISOTOPE SEPARATION IN A THREE-STEP MERCURY MASS DIFFUSION COLUMN. Nikolaev, B. I.; Sulaberidze, G. A.; Tevzadze, G. A.; Chuzhinov, V. A.; Osipov, G. A. At. Energ. (USSR), 24: 485-6(May 1968). (In Russian).

A design is given of a three-step cascade installation of mercury mass-diffusion columns used for separation of ^{22}Ne isotopes. Concentration and separation of ^{22}Ne were carried out at cascade pressure of 30 mm Hg, with steady state established after 7 to 8 hr. With 9% concentration of ^{22}Ne in the initial product, vapor flow density through the diaphragm was 2.6×10^{-3} $g/cm^2/sec$, and the concentration of extracted isotope reached 97%. (R.V.J.)

42986 SOME EXPERIMENTS WITH A RADIOISOTOPE X-RAY SOURCE FOR THE UNDERGRADUATE LABORATORY. Robinson, W. K. (St. Lawrence Univ., Canton, N. Y.). Amer. J. Phys., 36: 683-9(Aug. 1968).

Until recently x-ray experiments were done mainly in laboratories which had x-ray machines. With radioisotope x-ray sources now readily available, many experiments can now be performed in small universities with a minimum investment in equipment. A source used to excite fluorescent x rays in the 0 to 30-keV range in various metals is described. These x rays are studied with a conventional proportional counter and with one of the newly developed lithium-drifted silicon, Si(Li), surface barrier detectors. With this latter device resolutions as good as 450 eV are obtained for some of the x-ray measurements. The interaction of x rays with matter is studied by making half-value thickness measurements on aluminum, cobalt, and nickel, using ^{57}Co and ^{65}Zn sources. (auth)

42987 RADIOISOTOPE UND STRAHLEN IN INDUSTRIE UND TECHNIK. (Radioisotopes and Beams in Industry and Technology). Informationsheft des Buero Eurisotop, 3. Serie: Monographien 1. Brussels, Buero Eurisotop - Euratom, 1965. 99p. 3.50 DM.

Eleven articles reviewing the utilization of radioisotopes and radiations in industry and technology are compiled. The methods used for the preparation of artificial radioelements are outlined. The use of radioisotopes in the electronics, iron and steel, chemical and pharmaceutical, and textile industries is then described. The principle and applications of activation analysis are discussed. Radiation and radioisotopes in agriculture and the food industry are also considered. Problems in connection with the application of radioactive tracers in hydraulics are discussed. Radioisotopes in internal medicine are illustrated. The utilization of radioisotopes in the machine construction industry is also discussed. Present and future research problems in the industrial application of radioisotopes are reviewed. (J.S.R.)

42988 ^{192}Ir GAMMA-RAY AND ITS RADIOGRAPHY. Furuta, Junichiro; Hiraoka, Eiichi (Radiation Center of Osaka Prefecture). Hihaki Kensa, 17: 3-13(Jan. 1968). (In Japanese).

The fundamental characteristics of ^{192}Ir gamma rays used for nondestructive testing are described. ^{192}Ir sources used were 2mmφ × 2mm pellets of 6 and 10 Curies activity. Measurements of attenuation curves and radiographic fault sensitivities were carried out for aluminum, steel and lead, and the effectiveness of lead foil screens to image was also observed. Some of the results are as follows: 1) The effective energies to steel and aluminum were about 400 keV, and about 550 keV to lead. 2) HVL for steel was about 14mm. 3) The highest intensification to the films was observed with lead foil screens of 0.05mm in thickness, but good fault sensitivities were obtained with ones over 0.1mm in thickness. 4) The radiographic fault sensitivities of steel and aluminum were less than 2% over 15 ~ 20mm in thickness. It was concluded that if ^{192}Ir sources of higher activity were more easily obtained they would be used in more widespread applications. (NSA of Japan)

42989 MISCIBLE DISPLACEMENT THROUGH GAMMA RADIATION-STERILIZED SOIL COLUMNS. Corey, J. C.; Nielson, D. R.; Picke, J. C. Jr.; Kirkham, Don (Iowa State Univ., Ames). Environ. Sci. Technol., 1: 144-6(Feb. 1967). (COO-1269-14).

Gamma radiation from a ^{60}Co source has proved successful in sterilizing soil columns. Sterile miscible displacement methods were used to follow the displacement of nitrate at slow velocities through soils. After a soil column was sterilized, 100% of the nitrate added to a Webster soil-sand column was recovered in the effluent after displacement at 0.055 cm per hour, while 66% of the nitrate was recovered when displaced through a nonsterile column at the same velocity. (auth)

42990 PRACTICAL ASPECTS AND POTENTIALITIES OF ISOTOPIC GENERATORS. Rice, J. E. Newsletter Isotop. Generator Inform. Centre, No. 6, 80-95(May 1968).

A 5W isotopic generator—the ITG 109, which is a fully developed equipment, evolved from the RIPPLE series of generators and which is now available for land or submarine use—is described. The general characteristics of the ITG 109 are described, including the electrical performance, dimensions and weight. The rated power period is defined and attention is drawn to the two different types of output obtainable—either the "natural" power and voltage, supplied directly from the generator, or stabilized levels supplied during the rated power period. The costs of the present range of isotopic generators are given, in terms of total price, cost per watt and cost per watt-hour. The complete absence of any maintenance requirement is stressed. Practical applications, present and future, are considered for those marine, submarine and land environments where long, trouble free and continuous operation is essential. A typical existing installation is described. The complete safety of the range of isotopic generators and the relevant official documents which define the safety requirements are emphasized. (auth)

42991 ISOTOPIC GENERATORS IN MARINE NAVIGATIONAL AIDS. Clingan, I. C. Newsletter Isotop. Generator Inform. Centre, No. 6, 75-9(May 1968).

The application of isotopic generators to both major and minor navigational aids, e.g., floating buoys and light-vessels, and fixed off-shore lighthouses and structures and land-based installations, is discussed. The largest field of application is for buoys and similar minor aids which require only a few watts of power but are costly to operate and maintain. Many of these are still gas-operated but particularly since the development of electronic aids to supplement the basic visual and audible signals, electric power is becoming more widely adopted. Fuel costs are generally only a fraction of the operating costs of marine aids and the isotopic generator offers the advantage of a continuously available source of power of long life. Depending on relative costs, if by this means the frequency of costly maintenance visits to service equipment usually in difficult and inaccessible locations can be substantially reduced, then worthwhile economics may be achieved. The equipment itself will need to be developed to a similar degree of longevity but technically this is not insuperable. Similar considerations will apply to major aids but much depends on how the costs of isotopic generators increase with power rating. The question of nuclear safety which poses special problems for seaborne equipment will have to be resolved. (auth)

42992 THE ECONOMIC AND COMMERCIAL POTENTIAL OF ISOTOPIC GENERATORS IN CIVIL AVIATION. Clark, J. O. Newsletter Isotop. Generator Inform. Centre, No. 6, 57-73 (May 1968).

The scope and significance of civil aviation in worldwide commerce are outlined. A brief survey is made of power sources used in civil aviation communications and navigation systems. The airborne and ground applications are considered separately providing an indication of the operational requirements and consequent power levels. The significance of the additional freedom presented to aviation authorities in the siting of aviation communication and navigation aids when radioisotope power generators are used is emphasized. The first known application of radioisotope power generators in the field of civil aviation navigation and communications is described in detail from historical initiation up to the present state of planned implementation. (auth)

42993 GENERAL PRINCIPLES OF ISOTOPIC THERMOELECTRIC GENERATORS. Phillips, L. S.; Planer, G. V. Newsletter Isotop. Generator Inform. Centre, No. 6, 7-17(May 1968).

Isotopic thermoelectric generators are basically comprised of a radioisotope heat source; one or more thermoelectric modules to convert heat energy to electrical energy; and a power conditioning system to convert the normally low dc voltage output of the thermoelectric modules to the dc or ac voltage level required by the particular application. The following aspects of thermoelectric generators are discussed: the factors involved in the choice of a suitable isotope heat source for prolonged life, viz. half life, power density, type of decay, and availability; the parameters governing the selection of p and n-type semiconductor thermoelectric materials for use over various temperature ranges; the design of thermoelectric modules with special reference to the need for achieving a high degree of reliability over prolonged periods; the need for, and methods of, inverting the inherently low voltage output developed by the thermoelectric devices to higher voltages suitable for particular applications, e.g., pulsed or continuous load; and the factors governing the attainment of maximum conversion efficiencies at each stage. (auth)

Materials Testing

Refer also to abstracts 43013, 43070, 43173, 43189, 43519, 43543, 43570, and 44551.

42994 (ANL-7299, pp 173-97) DEVELOPMENT OF TECHNIQUES OF FABRICATION AND TESTING. (Argonne National Lab., Ill.).

Work directed toward development of fabrication methods for W and W alloy tubing is described. Research is also reported on dimensional and microstructural changes during hollow drawing of metal tubes. Other investigations are reported on nondestructive testing and techniques and equipment for alpha-gamma hot cell operation. (J.R.D.)

42995 (MLM-1499) PARTICLE SIZING OF PLUTONIUM DIOXIDE MICROSPHERES AFTER IMPACT. Bonnell, P. H. (Mound Lab., Miamisburg, Ohio). Dec. 11, 1967. Contract AT(33-1)-Gen-53. 36p. Dep. CFSTI.

Three capsules containing sized plutonium-238 dioxide microspheres were impacted onto a granite block. The fines (particles less than 44 μm in diameter) produced by damage to the microspheres were sized, and the percentage in each size range was determined. (auth)

42996 (NYO-2539-9) STRUCTURAL INTEGRITY OF SHIPPING CONTAINERS FOR RADIOACTIVE MATERIALS. PART X. CONSIDERATIONS FOR VERIFICATION OF RESISTANCE TO FIRE HAZARDS. Clarke, H. G. Jr.; Carfagno, S. P. (Franklin Inst. Research Labs., Philadelphia, Pa.). July 1968. Contract AT(30-1)-2539. 46p. Dep. CFSTI.

Consideration is given to methods of verifying that shipping containers for radioactive materials meet the requirements of thermal tests intended to prove resistance to fire hazards. Although the thermal integrity of many existing containers has been established analytically, it has been necessary to use supposedly conservative procedures because of our inadequate knowledge of the behavior of containers in high temperature environments. Because of the expense of testing large containers, small-scale testing is an attractive consideration. True thermal simulation may not be possible, but small-scale testing will be feasible if it can be verified, as is expected, that transient thermal conditions are relatively unimportant in determining the failure conditions of a container. Experimental studies are recommended to expand our knowledge of the problem and to verify and improve analytical procedures. An annotated bibliography and a list of some companies which have furnace facilities suitable for testing large shipping containers are included. (auth)

42997 (SwRI-1228-P-5-46) STUDIES OF THE FATIGUE STRENGTH OF PRESSURE VESSELS. FRACTURE TESTS OF ONE-HALF SCALE MODEL PRESSURE VESSELS. Technical Summary Report. Grigory, S. C. (Southwest Research Inst., San Antonio, Tex. Dept. of Structural Research). Apr. 29, 1968. Contract AT(11-1)-1228. 134p. Dep. CFSTI.

Results of hydraulic pressure, low cycle fatigue, and fast fracture tests on one-half scale model steel pressure vessels are reported. Data on experimental stress analyses, strain, tensile properties, and welding procedures are given and types of failures are shown photographically. (P.G.C.)

42998 GAMMA-RAY POSITIONING TIP. Naval Ship Syst. Command Tech. News, 17: 36(Jan. 1968).

Commercially available radiographic γ-ray positioning tips are susceptible to separation and deformation which could result in a radiation accident. The tip described is machined from a solid piece of aluminum and designed so that various clamping devices can be used to hold it in position during radiographic exposure. The tip has no moving parts, will not separate, and eliminates any possibility of radiation accidents due to source binding at a crimped or separated source tip. This positioning tip has been approved by the Atomic Energy Commission. (BBB)

42999 DO'S AND DON'TS FOR THE 24 MeV BETATRON AND YOU. Buckrop, R. L. (Rock Island Arsenal Lab., Ill.). pp 521-32 of Proceedings of the Sixth Symposium on Non-Destructive Evaluation of Aerospace and Weapons Systems Components and Materials, San Antonio, Texas. San Antonio, Texas, American Society for Non-Destructive Testing Inc., 1968.

See CONF-670426.

Betatron high energy radiography is discussed. The Betatron is a machine that imparts a very high velocity to a beam of electrons, so that when directed upon a target they produce x rays of great penetrating power. The principles of the Betatron are summarized. The radiographic uses to which the 24 MeV Betatron should and should not be applied are listed. Some practical applications of the Betatron at Rock Island Arsenal are given. (R.C.K.)

43000 POTENTIAL PROBLEMS OF IN-SPACE NONDESTRUCTIVE TESTING. Cooper, R. G.; Zoran, W. A. (United Aircraft Corp., Windsor Locks, Conn.). pp 503-20 of Proceedings of the Sixth Symposium on Non-Destructive Evaluation of Aerospace and Weapons Systems Components and Materials, San Antonio, Texas. San Antonio, Texas, American Society for Non-Destructive Testing Inc., 1968.

See CONF-670426.

The objectives of a program to prove the feasibility of nondestructive testing (NDT) for in-space use are outlined. These objectives include a study of in-space applications, anticipated problem areas related to the space environment, selection of optimum NDT methods for space hardware, and fabrication of a prototype in-space NDT unit. The four principal areas of in-space application are: damage assessment and repair, medical, space fabrication, and maintenance. A review was made of the various space vehicle types, structures contemplated, and defects expected. The fabrication and performance of NDT units are discussed. An integrated ultrasonic-radiographic demonstration unit was constructed using off-the-shelf ultrasonic and radiographic units. A requirement for in-space NDT capability for fabrication, quality analysis, damage assessment, and medical and maintenance functions is indicated for astronaut safety and successful mission performance. (R.C.K.)

43001 CHALLENGE OF NONDESTRUCTIVE TESTING IN OUTER SPACE. Beal, J. B. (George C. Marshall Space Flight Center, Huntsville, Ala.). pp 440-64 of Proceedings of the Sixth Symposium on Non-Destructive Evaluation of Aerospace and Weapons Systems Components and Materials, San Antonio, Texas. San Antonio, Texas, American Society for Non-Destructive Testing Inc., 1968.

See CONF-670426.

Studies are described of several conceptual designs for extended duration space stations. Because of size, most of these space stations will have to be at least partially fabricated in space. In-space fabrication studies, design and construction of in-space fabrication tools, (electron beam welders, minimum reaction power tools, etc.) and space tool operation are described. Nondestructive testing tools and techniques for in-space application are discussed. The use of radiographic and ultrasonic methods for inspection of brazed or welded tubing joints, liquid and gas storage containers, or critical engine components subject to fatigue cracking or delamination are envisioned for space station fabrication inspection. The radiographic inspection unit chosen for space use utilizes ytterbium-169 as the radiation source. Ytterbium-169 is compared with iridium-192 as the gamma source. It was concluded that there is an unlimited future for nondestructive testing in space. (R.C.K.)

43002 NUCLEAR TECHNIQUES IN NONDESTRUCTIVE TESTING. Jackson, C. N. Jr. (Battelle Memorial Inst., Richland, Wash.). Contract AT(45-1)-1830. pp 385-98 of Proceedings of the Sixth Symposium on Non-Destructive Evaluation of Aerospace and Weapons Systems Components and Materials, San Antonio, Texas. San Antonio, Texas, American Society for Non-Destructive Testing Inc., 1968.

See CONF-670426.

Gamma spectroscopy, alpha counting and X-ray fluorescence techniques have been developed and applied to testing nuclear reactor fuel elements. In about two minutes test time the gamma analyzer system incorporating a NaI(Tl) scintillator measures the enrichment level of the ^{235}U isotope over a 0.15 to 3.0 weight percent range with an accuracy of approximately 0.1 weight percent. An alpha scintillation counter system that features unusually sturdy mechanical configuration detects uranium contamination at the 100 microgram level in a 10 minute counting period. A prototype x-ray fluorescence system detected uranium contamination in a weld zone over a 2 to 10 weight percent range in a small volume (0.25×10^{-3} in.^{3}) at a scan rate of 5 in./minute. These techniques and in particular the x-ray fluorescence offer promising methods for testing impurity levels or alloying concentrations of space age components or materials. (auth)

43003 RADIOGRAPHIC EXAMINATION OF FILAMENT WOUND GLASS COMPOSITE STRUCTURES. French, C. R. (Aerojet-General Corp., Sacramento, Calif.). pp 159-79 of Proceedings of the Sixth Symposium on Non-Destructive Evaluation of Aerospace and Weapons Systems Components and Materials, San Antonio, Texas. San Antonio, Texas, American Society for Non-Destructive Testing Inc., 1968.

See CONF-670426.

The radiographic significance of structural defects in continuous wound filament composite structures is illustrated with cross-sectional views. Specific variables of joining cloth orientation, roving relaxation, reinforcement deformation and irregular indexing are discussed. Consideration is given to the importance of radiographic examination in the research and development phase with the objective of performing a limited amount of x-ray inspection of production run solid propellant rocket motor chambers. Methods of fabricating glass composites and thermal insulation are briefly described. Although salvage repair of defects in cured glass structures is limited, the potentials of a few repair techniques are reviewed. (auth)

43004 PROCEEDINGS OF THE SIXTH SYMPOSIUM ON NON-DESTRUCTIVE EVALUATION OF AEROSPACE AND WEAPONS SYSTEMS COMPONENTS AND MATERIALS, APRIL 17-19, 1967, SAN ANTONIO, TEXAS. San Antonio, Texas, American Society for Non-Destructive Testing Inc., 1968. 583p. (CONF-670426). Western Periodicals Co., North Hollywood, Calif., $20.00.

Thirty papers were presented at the conference. A separate abstract was prepared for each of 5 papers. The remaining 25 papers contain information on various nondestructive testing methods applicable to aerospace and weapons systems components and materials. (R.C.K.)

For abstracts of individual papers see: 42999–43003.

43005 PREDICTION OF STRENGTH OF GRAPHITIC MATERIAL BY NONDESTRUCTIVE TEST TECHNIQUES. Fanelli, L. H.; McKown, R. D. (North American Rockwell Corp., Los Angeles). pp 48-60 of Nondestructive Testing of Nuclear Graphite. Philadelphia, American Society for Testing and Materials, 1968.

From 70th Annual Meeting of the American Society for Testing and Materials, Boston. See CONF-670605.

A material consisting of zirconium diboride, zirconium carbide, and silicon carbide dispersed in a continuous graphite matrix was examined by nondestructive test techniques. To improve reliability of the material, a method of predicting strength was desired. Testing consisted of bulk density, penetrant, x-ray, eddy current, and ultrasonic measurements. These were correlated with compressive and flexural strength measurements. Penetrant, x-ray, and ultrasonic measurements, as performed, did not provide any useful information for the prediction of strength. Bulk density and eddy current measurements correlated with strength. Since density (and strength) were found to vary significantly over very short distances within the material, density alone did not provide sufficient information to predict strength. However, by the use of a combination of density to determine an average strength, and eddy current readings to measure local variations in strength, it was found that the strength of a graphite part could be predicted. (auth)

43006 A NOVEL INFRARED NONDESTRUCTIVE TESTING TECHNIQUE FOR DETERMINING THE THERMAL CONDUCTIVITY OF GRAPHITE. Schultz, A. W. (Avco Corp., Lowell, Mass.). Contract AF33(615)-3942. pp 70-86 of Nondestructive Testing of Nuclear Graphite. Philadelphia, American Society for Testing and Materials, 1968.

From 70th Annual Meeting of the American Society for Testing and Materials, Boston. See CONF-670605.

A unique method was developed for rapidly determining, nondestructively, the localized thermal conductivity, and thermal diffusivity of graphites near room temperature. The method employs transient heating and requires access to only one surface of a solid. It involves heating a small area on the surface of an apparent "semi-infinite" solid with radiant energy and simultaneously observing the parabolic-shaped temperature history of this area's center using an infrared radiometer as the sensor. This history is related to the thermal inertia of the solid, so that a comparison of it with a history for a "standard" material will yield the conductivity and diffusivity if the density and specific heat of the solid-of-interest are known. Typically, the period of time to generate a measurement is 10 sec, and the temperature rise is less than 10°C. Application of this technique to coated ATJ graphite indicates that it is capable of discerning inertia differences equal to 15%, conductivity differences of 15%, and diffusivity differences of 10%. Approximately 70% of the error contributing to these precision values is caused by variability in the applied coating thickness. Precision could ultimately be expected to increase to about 3%. The probable accuracy of the technique is limited to that of the standard and is about 9% for an inertia measurement when calibrated against Armco iron. Three noteworthy features of this method include: (1) point-to-point conductivity/diffusivity/inertia determinations, which afford an additional tool for nondestructively evaluating material variability; (2) extension of its application to poor thermal conductors, which will increase the method's precision; and (3) probable application to materials in elevated temperature environments. (auth)

43007 STRENGTH PREDICTIONS FOR GRAPHITE: A REVIEW OF PRIOR WORK AT AVCO SSD. Hastings, C. H. (Avco Corp., Lowell, Mass.). Contracts AF33(615)-1601; 3942. pp 87-96 of Nondestructive Testing of Nuclear Graphite. Philadelphia, American Society for Testing and Materials, 1968.

From 70th Annual Meeting of the American Society for Testing and Materials, Boston. See CONF-670605.

The correlation of nondestructive measurements and destructively determined mechanical properties was studied. General work in this area has been going on since 1958 and specifically on graphite since early 1964. Accomplishments include nondestructive testing capability for predicting density in small discrete volumes of bulk graphite to better than ±1%, Young's modulus to better than ±3%, and ultimate tensile strength (all at room temperature) to better than ±10%. Predictions can be made in five or six different aerospace (fine-grained) grades of graphite, for both with- and against-the-grain orientation, employing a single set of calibration curves. Experiments indicate the strong possibility of extension to other fine-grained graphites, including graphite composites containing additives such as silicon and zirconium diboride. (auth)

43008 APPLICATION OF ALCOHOL PENETRANT FOR EVALUATION OF SURFACE POROSITY OF GRAPHITE INSERTS FOR ROCKET NOZZLES. Hendron, J. A. (Aerojet-General Corp., Sacramento, Calif.). pp 37-47 of Nondestructive Testing of Nuclear Graphite. Philadelphia, American Society for Testing and Materials, 1968.

From 70th Annual Meeting of the American Society for Testing and Materials, Boston. See CONF-670605.

Detection of defect conditions in rocket nozzle graphite components, using clear alcohol as a penetrant, is described as an inspection method. Procedure and acceptance criteria used for graphite with densities of 1.60 to 1.80 are given. Porosity and density evaluation using standard test blocks is discussed relative to rocket test firing results. It is concluded that this method is the most valuable single inspection technique for graphite in this density range when the technique is compared to other common nondestructive tests. (auth)

43009 NONDESTRUCTIVE TESTING OF NUCLEAR GRAPHITE. A Symposium Presented at the Seventieth Annual Meeting, American Society for Testing and Materials, Boston, Mass., June 25-30, 1968. ASTM Special Technical Publication No. 439. Philadelphia, American Society for Testing and Materials, 1968. 114p. $8.00. (ASTM-STP-439; CONF-670605).

Eight papers were presented at the conference. A separate abstract was prepared for each of four papers. Four papers have previously appeared in NSA. For abstracts of these see CONF-670605 in the Report Number Index. (R.C.K.)

For abstracts of individual papers see: 43005–43008.

43010 SECONDARY EMISSION DURING BETATRON GAMMA DEFECTOSCOPY. Zol'nikov, P. P.; Dvinyaninov, B. L.; Sukhanova, K. A. (Ural Polytechnic Inst., Sverdlovsk, USSR). Defektoskopiya, No. 2, 56-60(1968). (In Russian).

The results of the calculation of the energy and angular distribution of the secondary emission of γ's, originating as a result of the interaction of the bremsstrahlung betatron radiation with lead and iron absorbers of different thicknesses are reported. The calculations were made by the Monte Carlo method on the EVM Ural-2. (tr-auth)

43011 CALCULATIONS OF OPTIMUM FOCUSING DISTANCE FOR MASS RADIOGRAPHIC STUDY OF OBJECTS WITH LONGITUDINAL WELDING SEAMS. Knyazyuk, L. V. Defektoskopiya, No, 3, 9-13(1968). (In Russian).

It is shown that the optimum focusing distance obtained by geometric and eigenvalue equation for x-ray film is not sufficiently accurate. A new method and equations are presented and a concrete example is given for demonstrating the radiographic parameters considered. (R.V.J.)

Protective Structures

Refer also to abstracts 42930 and 42931.

43012 (RRA-M-75) EXTENSION OF THE ENGINEERING METHOD TO IMPROVE FALLOUT PROTECTION FACTOR CALCULATIONS FOR BASEMENTS. French, R. L. (Radiation Research Associates, Inc., Fort Worth, Tex.). Nov. 3, 1967. Subcontract 2329. 16p. (CONF-671102-41).

For Oak Ridge National Lab., Tenn.

From 15th Conference on Remote Systems Technology and Atom Fair, Chicago, Ill.

The engineering method for determining the protection against fallout radiation afforded by basements was extended to include a geometry factor in calculating the contribution of radiation which scatters in the floor above the basement. This extension was accomplished within the framework of the original engineering method; no additional charts are required to use the extended method. Numerous comparisons were made with the results of experiments, Monte Carlo calculations, and the results of other proposed improved methods for basement calculations. It was found that in most cases the extended engineering method gave reduction factors well within 50 percent of those measured; whereas, the original engineering method often underestimated the reduction factors by a factor of 2 to 5. Other improved methods, all of which require the use of additional charts, were found to perform no better than the extended engineering method. (auth)

Radioactive Material Handling

Refer also to abstracts 43540 and 44940.

43013 (BNWL-797) EVALUATION OF KAOLITE-20 INSULATING CASTABLE. Davis, N. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1968. Contract AT(45-1)-1830. 57p. Dep. CFSTI.

Activities in a program to evaluate Kaolite-20 were concentrated on determining the physical integrity of this insulating castable by use of compressive strength tests made after various environmental conditioning which simulated the conditions of the proposed service in a radioactive waste storage tank installation. (auth)

43014 (BNWL-SA-1735) AIRBORNE RELEASE OF PARTICLES IN OVERHEATING INCIDENTS INVOLVING PLUTONIUM METAL AND COMPOUNDS. Schwendiman, L. C.; Mishima, J.; Radasch, C. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). July 31, 1968. Contract AT(45-1)-1830. 19p. (CONF-680811-1). Dep. CFSTI.

From Symposium on Operating and Developmental Experience in the Treatment of Airborne Radioactive Wastes, New York.

Observations are given from a study in which the airborne release of plutonium and its compounds was measured during an exposure of the material of interest containing plutonium to temperatures which may result from fires. Aerosol released from small cylinders of metallic plutonium ignited in air at temperatures from 410°C to 650°C ranged from 3×10^{-6} wt % to 5×10^{-6} wt %. Particles smaller than 15 μ in diameter represented as much as 0.03% of the total released. Large plutonium pieces weighing from 456 to 1770 grams were ignited and allowed to oxidize completely in air with a velocity of around 500 cm/sec. Release rates of from 0.0045 to 0.032 wt % per hour were found. The median mass diameter of airborne material was 4 μ. Quenching the oxidation with magnesium oxide sand reduced the release to 2.9×10^{-4} wt % per hour. Many experiments were carried out in which plutonium compounds as powders were heated at temperatures ranging from 700 to 1000°C, with several air flows. Release rates ranged from 5×10^{-6} to 0.9 wt % per hour, depending upon the compound, and the conditions imposed. The airborne release from boiling solutions of plutonium nitrate was roughly related to energy of boiling, and ranged from 4×10^{-4} to 2×10^{-1}% for the evaporation of 90% of the solution. The fraction airborne when combustibles contaminated with plutonium are burned is under study. The data reported can be used in assessing the consequences of off-standard situations involving plutonium and its compounds in fires. (auth)

43015 (DPSPU-67-30-8) NUCLEAR SAFETY IN FUEL RECEIPT AND STORAGE. Forstner, J. L. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). July 1968. 17p. (CONF-681001-3). Dep. CFSTI.

For Presentation at 2nd International Symposium on Packaging and Transportation of Radioactive Materials, Gatlinburg, Tenn.

Nuclear safety is of primary importance to the receiver of irradiated reactor fuel. Complete and accurate fuel identification and nuclear data are required by the receiver for detailed nuclear safety evaluation related to handling, storage, and processing of the spent fuel. Appreciation, by the shipper, of the receiver's particular nuclear safety problems will facilitate transmittal of the proper information and acceptance of the shipment. Various phases of fuel receipt and storage, methods used to carry out these functions safely, and examples of problems which have arisen are discussed. Facilities are described and nuclear safety calculations are briefly discussed. (auth)

43016 (DPSPU-67-30-9) SHIPPING CONTAINER FOR HEAT GENERATING NUCLEAR MATERIALS. Bass, R. J. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). June 1968. 8p. (CONF-681001-2). Dep. CFSTI.

For Presentation at 2nd International Symposium on Packaging and Transportation of Radioactive Materials, Gatlinburg, Tenn.

Special shipping containers are required for heat generating nuclear materials which are neutron emitters with gross alpha contamination potential. A review is made of the special requirements; and the design, testing and experience of a unique shipping container assembly used at the Savannah River Plant. (auth)

43017 (DUN-4250) EVALUATION OF EXISTING SHIPPING CONTAINERS FOR OFF-SITE SHIPMENTS OF RADIOACTIVE ISOTOPES. Ehlers, R. J. (Douglas United Nuclear, Inc., Richland, Wash.). June 3, 1968. Contract AT(45-1)-1857. 63p. Dep. CFSTI.

Three vessels, the HAPO 13, HAPO 14, and the Reed College casks are described and evaluated for off-site shipping of radioisotopes. After evaluation of the existing casks against the criteria of the regulations, it is concluded the casks do not meet the requirements for protection against fire and impact. With the addition of plywood buffers, the casks meet all requirements. (J.C.W.)

43018 (NSJ-tr-113) STUDY ON THE SOLIDIFICATION OF HIGH RADIOACTIVE LIQUID WASTE WITH CEMENT. Iwai, Shigehisa; Inoue, Yoriteru; Terasima, Yutaka; Aoyama, Isao. Translated from Hoken Butsuri, 1: No. 1, 12-19(Sept. 1966). 15p. Dep.

This paper was abstracted from the original language and appeared in NSA as 22: 4419. (J.R.D.)

43019 IMPROVEMENTS IN OR RELATING TO RADIOACTIVE-SOURCE TRANSFER MECHANISMS. Bailey, Peter John; Boston, Drysdale; Lockington, Derek Charles; Webster, Harold (to Nuclear Chemical Plant Ltd.). British Patent 1,120,182. July 17, 1968. Filed Nov. 9, 1964.

A radioactive-source transfer mechanism in which radioactive sources are spaced apart side by side in an operating position and moved separately or together on respective paths between the operating position and a shielded storage position is described. (W.H.K.)

43020 METHOD FOR CONTAINING RADIOACTIVE MATERIAL. Azuma, Masao (to Hitachi Ltd.). Japanese Patent 1968-874. Jan. 12, 1968. Filed Jan. 13, 1965.

A useful method is proposed for containing radioactive materials, especially damaged nuclear fuel rods. The advantages are high security against damage of a container and consequent surrounding contamination and high economy due to the reduced weight of the container. The method is applicable when radioactive material is loaded and contained in its container within the surrounding water pool. Water is also introduced in it with the material. An air space is provided at an appropriate position in the container. When water enters the container with radioactive material, the air collects into this space. This air space is utilized to absorb the pressure increase occurring with the container. (NSA of Japan)

Vacuum Engineering

Refer also to abstracts 42946 and 43185.

43021 (UCRL-18213) EVALUATING ULTRA VACUUM PUMPING AND OUTGASSING BY COUNTING IONS OR MEASURING ION CURRENTS. Milleron, Norman (California Univ., Berkeley. Lawrence Radiation Lab.). May 1968. Contract W-7405-eng-48. 13p. (CONF-680524-1). Dep. CFSTI.

From 1st Combined Symposium Delaware Valley Section and Greater New York Chapter-Thin Film Division, Princeton, N. J.

The environmental quality of vacuum is emphasized and the measurement of pump performance by means of the gas fluxes through the pump is discussed. The outgassing and backstreaming tester with a quadrupole analyzer and an in situ calibration procedure are described. Six commercial pumps (Welch turbomolecular, LN-trapped D. P., RCA sputter-ion Ultek sputter-ion, Varian sputter-ion, and N.R.C. Orbitron-type) were given preliminary tests, and the pumpdown performances are discussed. (D.L.C.)

43022 ULTRAHIGH VACUUM CRYOGENIC PUMP. Borovik, Evgeny Stanislavovich; Batrakov, Boris Pavlovich; Tugushev, Alexey Sergeevich (to Fiziko-Teknichesky Inst.). British Patent 1,117,822. June 26, 1968. Filed Mar. 8, 1966.

A cryogenic pump capable of evacuating hydrogen and neon at a pressure of 10^{-10} mm Hg is described. The system includes liquid cooled condensation elements mounted in the vacuum chamber. The liquid is supplied to each element by an independent liquefier operating in a closed circuit. One of the condensation elements is cooled by liquid hydrogen and another by a high-pressure helium heat-exchanger system. (W.H.K.)

43023 METHOD FOR MEASUREMENT OF VACUUM PRESSURE. McFarland, Robert H. (to United States Atomic Energy Commission). U. S. Patent 3,398,582. Aug. 27, 1968.

A pressure indicating system wherein the light quanta produced by electron-beam interaction with gas atoms in a high-vacuum environment is sensed by a photoelectric conversion device to produce an electrical output signal indicative of the gas atoms in said environment. (AEC)

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 44577, 44588, 44653, and 44674.

43024 (CONF-680441-1) RECENT ADVANCES IN COSMIC RAY PAYLOADS FOR INTERPLANETARY AND PLANETARY SPACECRAFT. Bartley, W. C.; Bickel, R. L.; Glasscock, H. W.; Stang, D. R.; Younse, J. M. (Southwest Center for Advanced Studies, Dallas, Tex.). [1968]. Contracts NAS2-1756; NAS5-9075; NAS2-3332. 7p.

From 18th National Telemetering Conference, Houston, Tex.

Utilization of available telemetry from new-generation scientific spacecraft is improved through increased on-board data conditioning. A 5.6 lb, 1.7 watt cosmic-ray anisotropy instrument aboard Pioneer VIII is described, which features a built-in computer for azimuth determination, command selectable subcommutation of an array of detectors, and logarithmic data compression. (auth)

43025 (EUR-3943) AUTOMATIC FLUX DISTRIBUTION RECORDING DEVICE FOR USE IN SUBCRITICAL ASSEMBLIES OR REACTORS. Fraysse, G.; Hage, W.; Pelah, I. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). June 1968. 10p. (In French). Dep.

The measurement of neutron flux distributions in a system requires the utilization of a convenient detector: activation detectors (individual samples, wires or ribbons) fission detectors (ionization chambers, semiconductors) or detectors based on a neutron reaction ($^{10}B(n,\alpha)-^{6}Li(n,\alpha)-^{3}He(n,\alpha)$). The difficulties arising from the simultaneous counting in a multiway device of each detector series have been mostly eliminated with a multiscalar analyzer in which the address and lack way are synchronized. Furthermore, simple address programming allows Fourier analysis of the spectra. The use of a multidimensional analyzer allows also the space representation of the neutron population, total or decomposed in its fundamental and harmonics for processing in a computer. (auth)

43026 (JINR-P13-3911) ADC OF PULSE HEIGHT ANALYZER HAVING 8192 CHANNELS. Imaev, E. G.; Prikhod'ko, V. I.; Sukhov, A. M.; Tishin, V. G.; Hoang Zuong Quan (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 15p. (In Russian). Dep.

The analog-digital converter of pulse height analyzer having 8192 channels was described. The analyzer is used with a semiconductor detector for measuring gamma spectra over a wide range of energies. (auth)

43027 (LA-DC-9801) CHARACTERISTICS AND APPLICATIONS OF A LARGE SODIUM IODIDE DETECTOR ASSEMBLY. Parker, Jack L.; Holm, Dale M.; Barnes, Barry K. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 12p. (CONF-681003-2). Dep. CFSTI.

For Presentation at International Conference on Modern Trends in Activation Analysis, Gaithersburg, Md.

Response functions were measured for a large sodium iodide double-crystal detector assembly. The assembly, used by itself and in conjunction with lithium-drifted germanium detectors, was studied for applications in activation analysis and gamma spectroscopy. (auth)

43028 (NYO-3870-1) HIGH-PURITY GERMANIUM FOR GAMMA DETECTORS. Annual Report No. 1, June 1967-April 1968. Hall, R. N.; Baertsch, R. D.; Soltys, T. J. (General Electric Co., Schenectady, N. Y. Research and Development Center). May 1968. Contract AT(30-1)-3870. 7p. Dep. CFSTI.

Experimental equipment and procedures for purifying germanium for use in p-i-n junction gamma detectors are described. The crystal growing furnace is described, and procedures for controlling impurities are discussed including crucible, furnace atmosphere, chemical processing, dust, source germanium, and intrinsic defects. Also, preparation of p-i-n detectors is outlined. (W.H.K.)

43029 (ORNL-TM-1638(Pt.36)) NUCLEAR INSTRUMENT MODULE MAINTENANCE MANUAL. PART 36. LOG CURRENT AND PERIOD AMPLIFIER, ORNL MODEL Q-2636. Anderson, J. L. (Oak Ridge National Lab., Tenn.). May 22, 1968. Contract W-7405-eng-26. 17p. Dep. CFSTI.

The circuit, application, maintenance procedures, and acceptance tests for a Log Current and Period Amplifier are described. This instrument accepts a positive input current from a gamma-compensated ionization chamber and produces a voltage output that is proportional to the logarithm of the input current. In addition, the logarithmic signal is differentiated and amplified, producing another output that is proportional to the reciprocal of reactor period. The useful input current range is 10^{-12} to 3×10^{-5} amp. The zero to +10 v output is expressed in percent power over 6.5 decades from 10^{-4} to 300%. The amplifier is packaged in a standard four-unit plug-in module of the ORNL Modular Reactor Instrumentation Series. (auth)

43030 (UJV-2034) CALCULATION OF THE CORRECTION FACTOR RESPECTING BURNUP OF ^{60}Co AND ^{59}Co IN COBALT DETECTORS. Rana, S. B. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). June 1968. 7p. Dep.

Values of the coefficient, f, which enables correction of the average Westcott flux due to burnup of ^{59}Co and ^{60}Co during long term measurements with a Co activation integrator, are tabulated. The correction coefficient f changes from negligible amounts at fluxes of the order 10^{12} n/cm^2/sec and irradiation time of the order of a few days to considerable amounts at fluxes of the order 10^{15} n/cm^2/sec. (auth)

43031 IMPROVEMENTS IN OR RELATING TO RADIATION DETECTORS. Saunders, Patrick William (to E. K. Cole Ltd.). British Patent 1,120,393. July 17, 1968. Filed May 6, 1965.

A position-sensitive scintillation detector system is described. The scintillator sections are divided by opaque strips, and each section is independently coupled to a photomultiplier tube. (W.H.K.)

43032 SEMICONDUCTOR DETECTORS FOR NUCLEAR PARTICLES. Berthelot, Jean (Societe Prana, Paris). Ind. At., 12: No. 1-2, 57-60(1968). (In French).

The characteristics of semiconductor detectors are outlined. The different types of detectors are given and the mechanism of energy loss is described. The collection of charges, more complicated than in gas detectors, is discussed. The properties of the signal are given and the background is evaluated. The factors affecting the selection of the semiconductor material are outlined. The application of these detectors to the detection of γ radiation is discussed. The technique for detection by carrier multiplication is discussed. (J.S.R.)

43033 NUCLEAR GEOPHYSICAL STUDIES. Geophysical Compilation No. 6. Yaderno-Geofiz. Issled., Geofiz. Sb., No. 6, 1-105(1967). (In Russian).

Aspects of nuclear-physics methods in geology are analyzed in the thirteen articles of the book. Interpretation of neutronometric data, methods and techniques of quantitative determination of Cu, Mg, and heavy metal ores using neutron activation and γ ray scattering are discussed. Studies of isotopic content and isotopic ratios of lead in order to improve geological and geochemical prospecting are covered. Descriptions are given of an express method for determining Ra concentrations and latent energy in aerodispersion media. Design, construction and performance of radiometric instruments are also discussed. (R.V.J.)

43034 USE OF A SOLID LIGHT FUNNEL TO INCREASE PHOTOTUBE APERTURE WITHOUT RESTRICTING ANGULAR ACCEPTANCE. Hinterberger, H.; Winston, R. (Univ. of Chicago). Rev. Sci. Instrum., 39: 1217-18(Aug. 1968).

A solid light funnel, optically wetted to the photomultiplier tube with the same index, is described for increasing light collection efficiency of a photomultiplier tube. A hollow light collection funnel is also used. The light funnel described has been used with Cherenkov detectors. (W.H.K.)

43035 TRITON X-100 SCINTILLANT FOR ^{14}C LABELLED MATERIALS. Turner, J. C. (United Kingdom Atomic Energy Authority, Amersham, Eng.). Int. J. Appl. Radiat. Isotop., 19: 557-63(July 1968).

Toluene/Triton X-100 liquid scintillant was found to possess excellent characteristics for the counting of a wide variety of carbon-14 labelled compounds. The counting characteristics of the scintillant for aqueous samples containing carbon-14 and tritium were examined in detail. The scintillant has a number of very useful properties. Materials which are poorly soluble or insoluble in organic solvents may be incorporated in large quantities, maintained as stable homogeneous solutions for extended periods of time, and counted at high efficiency. The scintillant shows considerable resistance to quenching effects from aqueous samples, particularly aqueous acids. (auth) (UK)

43036 DEVICE FOR DETECTING THE RADIOACTIVE CONTAMINATION OF A SURFACE. Cottignies, Stanislas (to

Commissariat a l'Energie Atomique). British Patent 1,120,644. July 24, 1968. Priority date Dec. 10, 1964, France.

The design of a system of Geiger–Mueller counters for detecting radioactive contamination on surfaces is described. A series of equidistant detectors disposed in at least one column are used to sweep successive portions of the surface at a constant speed. (W.H.K.)

43037 ^{14}C AND TRITIUM DETERMINATION BY THE LIQUID-SCINTILLATION-COUNTING TECHNIQUE AND ITS ADAPTATION TO MICROBIOLOGICAL EXPERIMENTS. II. Mison, P.; Trnka, L.; Meissner, J. G-I-T (Glas- Instrum.-Tech.) Fachz. Lab., 11: No. 2, 79-89(1967). (In German).

The effect of quenching, the means of establishing the counting yields, and methods for the preparation of samples are reviewed. A combustion flask for the oxidation and preparation of microbiological samples (e.g., Mycobacterium tuberculosis) is described, and the effect of various amounts of bacteria on the counting yield and quenching is investigated. (Anal. Abstr.)

43038 ^{14}C AND TRITIUM DETERMINATION BY THE LIQUID-SCINTILLATION-COUNTING TECHNIQUE AND ITS ADAPTATION TO MICROBIOLOGICAL EXPERIMENTS. I. Mison, P.; Trnka, L.; Meissner, J. G-I-T (Glas- Instrum.-Tech.) Fachz. Lab., 11: No. 1, 2-8(1967). (In German).

A review of various scintillator systems for carbon-14 and tritium determination in microbiological samples is presented. (Anal. Abstr.)

43039 GRAPHIC METHOD FOR THE EXPERIMENTAL DETERMINATION OF THE OVER-ALL CORRECTION FACTOR IN NUCLEONIC COUNTING INSTRUMENTS. Glaeser, M. (Paedagogische Hochschule, Potsdam, Ger.). Isotopenpraxis, 4: 169-75 (May 1968). (In German).

A description is given of a graphic method for the experimental determination of the over-all correction factor in nucleonic counting instruments, especially with Geiger–Mueller counters. The main requirements for the application of this method are: a) several similar nuclear radiation sources which differ exclusively in their activities by about the factor five, b) constant experimental geometry which is not influenced by changing the radiation sources. It could be shown that the method described for the direct experimental determination of the over-all correction factor ($g = z_W/z$) is superior to the methods known hitherto, especially for practical reasons (z_W = actual counting rate, z = registered counting rate). (auth)

43040 THE MEASUREMENT OF LOW ENERGY X-RAYS. II. TOTAL ABSORPTION CALORIMETRY. Greening, J. R.; Randle, K. J.; Redpath, A. T. (Edinburgh Univ.). Phys. Med. Biol., 13: 359-69(July 1968).

A calorimeter is described for the measurement of energy fluence in beams of low energy x-rays (30 kV and below) in which the beams are totally absorbed in a thin gold target. A thermistor bridge, together with ac amplification and phase sensitive detection, is used to detect the temperature rise of the absorber. Various methods of comparing the thermal response to x-rays and electrical heating were analyzed and were tested experimentally. (auth)

43041 APPLICATION OF AN INTEGRATING TYPE IONIZATION CHAMBER TO MEASUREMENTS OF RADIATION IN SPACE. Kane, Sharad Ramchandra. Minneapolis, Univ. of Minnesota, 1967. 220p.

Thesis.

An integrating type ion chamber experiment, using a resetting drift-type electrometer and designed to fly on the OGO-I and III satellites, is described. The chamber is demonstrated to have an accuracy and stability of ≃1% during its operation in space over a period of nearly three years. The minimum energy for penetration by protons and electrons is 12 and 0.6 MeV respectively. The response to 40 keV electrons (through bremsstrahlung) is about 10^{-7} × (response at energies > 600 keV). The response to x-rays in 10 to 150 keV range is peaked at ≃20 keV; below 10 keV the response is ≃10^{-2} × (response at 20 keV). For 1 particle cm^{-2} sec^{-1} of 20 keV photons, electrons with energy ≥1 MeV, and minimum ionizing nuclei with charge Ze, the pulsing rate of the chamber is respectively, 0.2, 7.0, and 5.5 Z^2 NPPS (Normalized Pulses Per Second) × 10^3. The OGO-I and III ion chamber measurements reported cover the period September 10, 1964–July 2, 1966, a period following the minimum in solar activity. (TSS) (Disser. Abstr.)

43042 LARGE-AREA SCINTILLATION DETECTOR. Ivanenko, V. M. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 7: 61-6(1967). (In Russian).

The parameters and characteristics of a scintillation detector with 9 m^2 surface based on the liquid scintillator ZHS-20 A were calculated. The optimum number of photomultipliers and homogeneity of the light faults were evaluated. The sensitivity threshold of the detector and photomultiplier feed regime were calculated. A block diagram of the detector working in combination with spark chambers was given. (tr-auth)

43043 SEMICONDUCTORS FOR RADIATION MEASUREMENT. Lauber, Alexander (Aktiebolaget Atomenergi, Nykoeping, Sweden). Tek. Tidskr., 98: 459-63(1968). (In Swedish).

A review is given on the use of semiconductors as detectors in radiation measurements. The electronics is briefly described. Some applications are mentioned such as monitoring of plutonium-239 in living tissues and analysis of cosmic radiation. (Swed)

43044 EVALUATION OF A METHOD FOR ASSAY OF TRITIUM SOLUTIONS USING A SEALED STANDARD. Burke, C. W. (Post Graduate Medical School, London). Int. J. Appl. Radiat. Isotop., 19: 597-600(July 1968).

Pulse height shift in liquid scintillation counting occurs on alteration of the channels ratio (counts in monitor channel/counts in counting channel). For tritium, a linear relationship between channels ratio and counting efficiency can be produced if the right discriminator settings are used. This linear relationship holds true over a wide range of efficiencies, independently of the chemical nature of quenching agents, provided color quenching is not severe. It is suggested that extrapolation of the line to the higher efficiency of a sealed standard will enable unknown samples to be standardized. This possibility is examined and some factors in its validity are presented. (auth)

43045 OPTICAL TRANSFER FUNCTION OF SCINTILLATION CAMERA. Hattori, Hiroyuki (Aichi Cancer Center Research Inst., Japan); Kaneko, Masao. Radioisotopes (Tokyo), 17: 302-6(July 1968). (In Japanese).

Optical transfer function (OTF) of radioisotope scintillation camera for radioisotope distribution in tissue equivalent materials was determined experimentally by means of Fourier transform of line spread function measured by using ^{131}I γ-ray line source. Also, for comparing with scinti-camera, OTF of radioisotope scanning system in the same condition above was measured by the same method. These results were, for example, as following: the spatial frequency which gives the value of 0.1 for OTF is 1.0 lines/cm for the combination of pinhole collimator and scinti-camera in magnification 1.76, 0.44 lines/cm for the multichannel collimator and scinti-camera and 0.27 lines/cm for scinti-scanner mounted 10 cm focus honey cone collimator for radioisotope distribution in 10 cm depth of tissue. (auth) (NSA of Japan)

43046 DEVELOPMENT OF UNIVERSAL SCINTILLATION SCANNER. Kashiwazaki, Masaaki; Kurihara, Shigeyasu (Tokyo Shibaura Electric Co., Ltd.). Radioisotopes (Tokyo), 17: 280-6 (July 1968). (In Japanese).

Using two 5 in. in diameter and 2 in. thickness NaI(Tl) scintillation detectors, a new scanner was developed which can be used for conventional area scanning, isosensitive scanning, laminoscanning, positron scanning and double tracer scanning. The scanner consists of following parts: two 5 in. ϕ × 2 in. NaI(Tl) detectors and their collimators, two supporting units, a scanning device, two spectrometer and scalers, two recording units, and an operation selector. Each detectors is supported by the supporting unit and its weight is balanced with a counter weight in the supporting post. Detectors are connected with the scanning device by connecting rod which is moved rectilinearly. Two detectors can be set each in the opposite side of a patient or in the same side. Detected signals of detectors are fed into an operation selector, in which pulses are devided or mixed, and then fed into the spectrometers and scalers. After amplifying and analyzing in the spectrometer, signals are fed into recording units which consists of dual channel photo and dot recorders. With such a new scanner, various scanning techniques as above mentioned are done with easy operation and high accuracy. (auth) (NSA of Japan)

43047 GAMMA-RAY MONITOR EQUIPPED WITH AN ALARM SYSTEM FOR THE CRITICAL POINT. Keller, J. (Central Lab. for Radiation Protection, Warsaw). Meres Automat. 16: 215-17(May 1968).

In a lecture delivered at a conference on medical technology during September, 1967, an experimental radiation detector was described for the measurement of γ-radiation dose rates in the 1 mR/hr to 30 R/hr range, equipped with an alarm trigger that disconnects the magnetic amplifier if the radiation dosage rate reaches a predetermined value. The device, described and illustrated in detail, comprises a radiation-detecting probe (consisting of pulse and current Geiger–Mueller counters in parallel), a transistorized amplifier with a magnetic power amplifier with its own power supply, and a conventional recorder. The device is now being evaluated. No references. (auth)

43048 IN-CORE RADIATION DETECTOR FOR MONITORING PULSED REACTOR EXCURSIONS. Todt, W. H. (Westinghouse Electric Corp., Elmira, N. Y.). Nucl. Appl., 5: 173-8(Sept. 1968).

An in-core radiation detector was developed to measure intense radiation levels present in pulsing reactor cores. Test results are shown for Triga and Pulstar excursions with peak power levels of 150 MW and 1000 MW, respectively. Life data indicate no deterioration in detector characteristics after >800 Triga pulses. (auth)

43049 CALCULATION OF THE CURRENT AND VOLTAGE PULSES OF GEIGER-MULLER COUNTERS. Seifart, M. (VEB Vakutronik WIB, Dresden). Kernenergie, 11: 154-62(June 1968). (In German).

Starting from a simplified consideration of the discharge process, shape and amplitude of the current and voltage counter pulses were calculated for the organically and halogen-quenched counter tube. Effects of counter operating voltage, working resistance, and shunt capacitance are taken into account. For some usual input circuits (RC and transformer coupling) calculations were performed of the output pulses of the coupling network. The transformer coupling is found to give maximum pulse height as a function of the transformation ratio. Checking the most important results by some measurements with the use of the VEB Vakutronik WIB Dresden counters of Va-Z-112 and VA-Z-118 type showed sufficient agreement. (auth)

43050 THE SOLID-STATE TRACK DETECTOR: PHYSICAL FOUNDATION AND APPLICATION IN NUCLEAR PHYSICS, NEUTRON DOSIMETRY, AND RADIOACTIVE DATING. Stolz, W.; Doerschel, B. (Technische Univ., Dresden). Kernenergie, 11: 137-47(June 1968). (In German).

The mechanism of track formation in solids, the etching process, the recording factor, and track fading are discussed. Also, applications of the solid-state track detector in nuclear physics, neutron dosimetry, and radioactive dating are described. (auth)

43051 SCINTILLATION DECAY OF ANTHRACENE EXCITED BY ALPHA PARTICLES AND ELECTRONS. Sjoelin, P. G. (Aktiebolaget Atomenergi, Studsvik, Sweden). Nucl. Instrum. Methods, 63: 253-7(Aug. 15, 1968).

The initial scintillation decay of some anthracene scintillators has been investigated by a delayed coincidence method. The results of the measurement are that the decay of anthracene excited by electrons within the investigated interval can be represented by a single exponential. In the decay corresponding to alpha excitation, in addition to a component with similar decay time to that in the case of electron excitation, there is evidence of the existence of a component with a much shorter decay time. The results are compared with the theoretical predictions of Blanc et al. (auth)

43052 EFFECTS OF FINITE SIZE IN 4π-RECOIL PROPORTIONAL COUNTERS. Gold, R.; Bennett, E. F. (Argonne National Lab., Ill.). Nucl. Instrum. Methods, 63: 285-99(Aug. 15, 1968).

An analysis of finite size effects in 4π proton-recoil proportional counters is given from the viewpoint of an unfolding problem. The response function is determined empirically. Experimental and analytical methods used to obtain proportional counter response functions are described. Iterative unfolding is employed to obtain distortion-free proton-recoil spectra from about 0.5 MeV upwards; an energy region subject to increasingly severe wall-and-end effect corrections. (auth)

43053 BEHAVIOR OF IONIZATION CHAMBER-NEUTRON DETECTORS IN INTENSE TRANSIENT GAMMA FIELDS. Gozani, T. (Gulf General Atomic Inc., San Diego, Calif.). Nucl. Instrum. Methods, 63: 307-12(Aug. 15, 1968).

The use of fast neutron detectors that are only slightly sensitive to gamma radiation coupled with fast preamplifiers and a linear gate has created the capability of measuring the time behavior of the neutron population very close in time to the bremsstrahlung burst from a linear accelerator. Three neutron detectors were investigated in high transient gamma fields. They are totally depleted silicon solid state detector with fission conversion foil, small fission chamber and small ^{10}B-coated proportional counter. These detectors coupled with proper electronics have yielded reliable results as early as a few hundred nanoseconds after the gamma burst. (auth)

43054 REJECTION OF SPURIOUS COUNTS ARISING FROM ELECTRICAL NOISE. Silverstein, E. A. (Case Western Reserve Univ., Cleveland). Nucl. Instrum. Methods, 63: 345-6 (Aug. 15, 1968).

A description is given of a method for eliminating spurious counts arising from electrical noise in nuclear counting circuits. (auth)

43055 FAST-RESPONSE GAMMA THERMOMETERS. Stutheit, J. S. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Contract AT(07-2)-1. Nucl. Instrum. Methods, 63: 300-6(Aug. 15, 1968).

Reliable fast-response gamma thermometers which were developed for reactor in-core gamma flux monitoring at the USAEC Savannah River Plant are described. These instruments have long in-core life with constant sensitivity. They are rugged, relatively simple, and low in cost. Design considerations are gamma sensitivity, neutron sensitivity, time response and heat losses. Operating experience has been satisfactory. (auth)

43056 THIN LARGE AREA PLASTIC SCINTILLATION COUNTER FOR THE STUDY OF PRIMARY COSMIC RAYS. Agrawal, P. C.; Kunte, P. K. (Tata Inst. of Fundamental Research, Bombay). Nucl. Instrum. Methods, 63: 258-62(Aug. 15, 1968).

A large area thin plastic scintillation counter for studies of the heavy nuclei component of primary cosmic rays is described. The counter is based on the principle of diffuse reflection of light. Its light collection efficiency is estimated and various factors like Landau fluctuations, photoelectron statistics, non-uniformity of light collection, etc., are discussed. Non-uniformity of light collection is determined experimentally and found to be about 20%. Resolution of about 35% is consistently obtained with sea level mu-mesons for cylindrical scintillators of size 16'' dia × ⅛'' thickness. (auth)

43057 MINIATURE SEMICONDUCTOR Si(Li) DETECTORS. Petushkov, A. A.; Meshcheryakov, A. B. Izmer. Tekh., No. 8, 98-9(Aug. 1968). (In Russian).

Descriptions are given of techniques for producing miniature Si(Li) detectors based on large detectors cut up into small portions. The smallest cylindrical detectors fabricated were 1.4 mm in diameter and 2.4 mm high. (R.V.J.)

43058 DOUBLE SCATTERING OF NEUTRON IN A STILBENE SCINTILLATOR. Furuta, Junichiro; Fujishiro, Masatoshi; Azuma, Toshin. Annu. Rep. Radiat. Center Osaka Prefect., 8: 85-8(1967).

Calculations and experimental measurements to determine the effects of the double scattering of neutrons on the efficiency of stilbene scintillators are discussed. It was found that for neutrons of energy below a few MeV the effect is no longer negligible when the thickness of the scintillator is thicker than 1.0 cm. (auth)

43059 REDUCING THE COST OF LIQUID SCINTILLATION COUNTING OF AQUEOUS SAMPLES OF TRITIUM. Burke, C. W.; Humphrey, K.; Beardwell, C. G. (Postgraduate Medical School, London). Int. J. Appl. Radiat. Isotop., 19: 665-6(Aug. 1968).

Reference is made to D. R. White (loc. cit. 19: 49(1968)) on the above subject. The authors also found that the cost of using naphthalene/dioxan scintillators can be reduced without loss of usefulness. Cost figures for the scintillator solutions are tabulated, showing the effect of cheaper reagents, together with counting efficiencies. It was concluded that the cost of using scintillation grade materials is so high that it does not appear justified by the gain in efficiency for routine purposes. (UK)

43060 SIMPLE TECHNIQUE FOR COLLECTING $^{14}CO_2$ UNDER REDUCED PRESSURE FOR LIQUID SCINTILLATION COUNTING. Houminer, Y.; Weinstein, M. (Hebrew Univ. of Jerusalem). Int. J. Appl. Radiat. Isotop., 19: 663-4(Aug. 1968).

In a kinetic study of the pyrolysis in vacuo of ^{14}C-labeled sugars it was necessary to determine separately $^{14}CO_2$, ^{14}CO, and other evolved gases without disturbing the reaction environment. The gases were liberated in small amounts, of relatively low activity, under reduced pressure, and collected separately during the whole of the reaction period, using methanolic hyamine solution as absorbent for the CO_2. The ^{14}CO and $^{14}CO_2$ were liberated simultaneously, the latter being condensed in a liquid nitrogen cooled trap. At the end of the run the condensed $^{14}Co_2$ was distilled off by replacing the liquid nitrogen by a CO_2-acetone bath. The $^{14}CO_2$ was absorbed in the hyamine, the time necessary for total absorption being about 45 min. A toluene scintillation solution was then added and the sample counted in a liquid scintillation spectrometer. (UK)

43061 AN EXTENSION AND EXPERIMENTAL EXAMINATION OF GREENING'S THEORY OF THE VACUUM CHAMBER. Burlin, T. E.; Husain, S. R. (The Polytechnic, London). Brit. J. Radiol., 41: 545-51(July 1968).

Greening's theory of vacuum chambers predicts some distinct contrasts in the saturation characteristics of two chambers. The characteristic of a spherical chamber in an attenuated radiation field is predicted to be (1) displaced, (2) asymmetrical, (3) distorted, while that of a parallel plate chamber in an unattenuated radiation field is predicted to be (1) undisplaced, (2) symmetrical, (3) undistorted. These predictions have been confirmed experimentally. It is also noted that his estimates of the number of low energy electrons were reasonably accurate and that his estimate of their energy spectrum had the right general shape, though it was too heavily weighted towards high energies. It is therefore concluded that Greening's theory of vacuum chambers is correct, at least in all the major features. (auth)

43062 APPARATUS FOR DIGITAL EVALUATION OF CORRECTIONS IN COINCIDENCE MEASUREMENTS. Seda, Josef (Technical Univ., Prague). Int. J. Appl. Radiat. Isotop., 19: 631-6(Aug. 1968).

A method and apparatus are described by which measurements of the activity of $\beta-\gamma$ emitters by the coincidence method are automatically corrected for dead time, random coincidences and background. The output of the equipment shows the corrected value of disintegration rate in digital form immediately after measurement. The principles used can be applied to other forms of correction. (auth) (UK)

43063 METHODS OF STANDARDIZATION OF RADIOACTIVE SOURCES AND OF GRADING OF RADIOMETRIC AND DOSIMETRIC EQUIPMENT. Baykalov, S. N.; Vasil'ev, R. D.; Garapov, E. F. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr., No. 1, 199-212 (1964). (In Russian).

Problems of ionization measurements, including the preparation of procedural instructions for the calibration of experimental and operational emitters, preparation of tasks concerning the development of experimental equipment and emitters, aid to enterprises and verification of model equipment, and the examination and confirmation of verification diagrams are discussed. Procedures for the metrology of alpha, beta, gamma, and neutron radiation are also described. The development of standard equipment to transmit the dimensions of the various units of measurements, ranging from sample measures of the first grade to working measures, and also equipment to facilitate the grading of instruments and the standardization of experimental and operational emitters are outlined. (ATD)

43064 SURVIVABILITY STUDIES OF LITHIUM DRIFTED SILICON DETECTORS UNDER SEVERE ENVIRONMENTAL CONDITIONS. Hubbard, E. L. (Philco-Ford Corp., Palo Alto, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-15: No. 4, 14-20(Aug. 1968).

Several lithium-drifted silicon, surface barrier detectors were subjected to a variety of environmental conditions. The conditions were primarily those of long term storage under ambient temperature conditions and of long time operation under both ambient and high (+60°C) temperature operation. Use was made of the temperature dependence of the diffusion coefficient of lithium in silicon so that elevated temperatures could be used to decrease the time scale of the tests. Some detectors were also subjected to a series of vibration and shock tests. The entire set of tests was performed in an effort to see if the detectors could withstand the rigors of the Apollo mission. The results of all the tests are given. (auth)

43065 TELESCOPE DEVICE FOR CHARGED PARTICLES FROM NUCLEAR REACTIONS INDUCED BY FAST NEUTRONS. Breunlich, W. H. Oesterr. Akad. Wiss., Math.-Naturwiss. Kl., Sitzungsber., Abt. II, 175: 17-46(1966). (In German).

The investigation of the properties of a telescope arrangement for the detection of charged particles from reactions of the type (n,charged particle) shows that with respect to the blanks and decay coincidences an arrangement is suitable in which a proportional counter and a semiconductor detector are used as ΔE detectors and semiconductor detector is used as E detector. The energy resolution in the detection of charged particles can theoretically be so improved that it is determined only through the detectors used. On the basis of the developments in the preparation of semiconductor detectors, an energy resolution of approximately 50 keV should be obtainable. The biggest disadvantage of this detection method is that the neutron flux at the site of the detector must be not much greater than 10^6 neutrons/cm^2 sec. This means that the technically obtainable high neutron fluxes cannot be used and therefore in the interest of sufficient response probability a poorer energy resolution must be accepted. In the literature values of 300 to 400 keV were given for the energy resolution and therefore values between 100 and 200 keV with sufficient response probability should be obtainable with the device described. (tr-auth)

43066 SEMICONDUCTOR DETECTORS IN ISOTOPE TECHNIQUE. Schuricht, V. (Technical Univ., Dresden). Isotopenpraxis, 4: 197-206(June 1968). (In German).

The properties of semiconductor detectors including principal structure, operation, and types are discussed. The application of these detectors in biology, medicine, radiation protection and engineering is described. (B.G.D.)

43067 SIMPLE AUTOMATIC SAMPLE CHANGER IN LIQUID SCINTILLATION COUNTING. Winkler, K.; Peters, A.; Karsten, D.; Schneider, K.-H.; Franke, J. (Deutsche Akademie der Wissenschaften, Berlin. Bereich Wissenschaftlich-Technische Versorgung, Berlin). Isotopenpraxis, 4: 206-12(June 1968). (In German).

An automatic sample changer with rotating plate on which the sample containers are brought in direct optical contact with but one scintillation head is described. (auth)

43068 FAST NEUTRON DETECTOR USING INSULATING MATERIALS. I. Furuta, Junichiro; Hiraoka, Eiichi; Ohnishi, Tokuhiro. Annu. Rep. Radiat. Center Osaka Prefect., 8: 100-2 (1967).

A fast neutron flux monitor is described. Recoil protons from a plastic scatterer are detected by parallel-plate electrodes which sandwich the plastic target. The monitor sensitivities observed are 5.6×10^{-19}, 2.8×10^{-19}, and 3.0×10^{-19} Amp/neutron/min for the neutrons from T(d,n)^{4}He, D(d,n)^{3}He, and ^{9}Be(d,n)^{10}B reactions, respectively. (W.H.K.)

43069 CURRENTS PULSES IN SEMICONDUCTOR DETECTORS. Poenaru, D. N. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz., 20: 561-75(1968). (In Rumanian).

The utilization of short current pulses given by L- and U-type semiconductor radiation detectors was investigated. The maximum amplitude and minimum length of the current pulses from silicon detectors were calculated and plotted against resistivity for L detectors and voltage for U detectors. By using a low input impedance, fast transistor current-sensitive preamplifier, L-detector exponential current waveforms (for 4 MeV protons, 5–15 MeV alpha particles and fission fragments) were verified. The possibility of employing current pulses for heavy charged particle spectrometry and of obtaining simultaneously fast and slow pulses from the same detector was also checked experimentally. (auth)

43070 TRANSMISSION OF THE X-RAY SHADOW CONTRAST BY CsI(Tl) AND NaI(Tl) MONOCRYSTAL SCREENS WORKING WITH A BETATRON AND ^{60}Co. Gromov, Yu. V.; Yakobson, A. M. Defektoskopiya, No. 3, 7-9(1968). (In Russian).

Variations of optical image contrasts in a defectometer with CsI(Tl) and NaI(Tl) converters were studied during operations with ionizing betatron radiation at 17 to 25 MeV and with Co-60. It is shown that 10 to 30 mm thick monocrystalline screens transmit complete x-ray image shadow contrast. (R.V.J.)

43071 CIRCUIT FOR DISCRIMINATION OF PULSES FROM FISSION FRAGMENTS AND ALPHA PARTICLES IN ZnS(Ag). Kraitor, S. N. Prib. Tekh. Eksp., No. 3, 63-5(May-June 1968). (In Russian).

A circuit for the discrimination of pulses corresponding to different scintillation times, which are based on the comparison of the current pulses of the photomultiplier tube, was proposed. The calculation was made for the case of discrimination of pulses from fission fragments and α particles in ZnS(Ag). The discrimination circuit was illustrated, and the fission fragment spectrum with and without form discrimination of the pulses was shown. In the first case errors were reduced by 5 times. The possibility of using the discrimination method for other particles and scintillators was indicated. (tr-auth)

43072 DIFFUSION SCINTILLATORS WITH COMPLETE OPTICAL CONTACT. Tsirlin, Yu. A.; Sokolovskaya, T. I.; Polyakova, S. B. (Scientific Research Inst. of Monocrystals, Kharkov). Prib. Tekh. Eksp., No. 3, 58-62(May-June 1968). (In Russian).

Methods for the determination of the coefficient of light collection and the resolution of cylindrical scintillators with diffusion reflecting walls were examined. The cylindrical scintillators were in complete optical contact with the photomultiplier tubes. The examination was done by calculations and model formulation. It was shown that for cases where the absorption is not large the coefficient of light collection can be calculated by formulas of photometric spheres or on the basis of the theory of diffusion light guides with a precision of ~10%. In the case where the absorption is large the coefficient of light collection and the resolution of the scintillators with different absorption coefficients can be determined by means of model tests. (tr-auth)

43073 TIME RESOLUTION OF SEMICONDUCTOR GAMMA DETECTORS. Bespyatov, Yu. D.; Kol'tsov, G. I. Prib. Tekh. Eksp., No. 3, 54-7(May-June 1968). (In Russian).

Theoretical and experimental studies of the transition process were made for silicon semiconductor γ detectors. The results of the theoretical calculations and the test results from a linear accelerator agreed well. (tr-auth)

43074 PULSE DISCRIMINATION IN PROPORTIONAL COUNTERS WITH RESPECT TO RISE TIME. Pomanskii, A. A.; Severnyi, S. A. (Physics Inst., Moscow). Prib. Tekh. Eksp., No. 3, 51-3(May-June 1968). (In Russian).

The possibility of using the differences in the rise time of the true and false pulses to reduce the background of the counter, used for the registration of ^{37}Ar decays, was investigated. The discrimination method was based on the fact that the doubly-differentiated pulses intersect no lines at the moment of time which depends only on the constant rise time and the constant time of the differentiating chain. The method developed can be successfully used for the discrimination of pulses formed by particles whose path lengths in the counter differ 100 times and more. (tr-auth)

43075 MASS SPECTROMETRIC METHOD FOR DETERMINING THE RATIO OF THE EFFECTIVE IONIZATION CROSS SECTION TO THE FORMATION OF ION PAIRS IN AN IONIZATION CHAMBER. Ivanov, Yu. M.; Vanyukov, A. V. (Moscow Inst. of Steel and Alloys). Prib. Tekh. Eksp., No. 3, 145-7(May-June 1968). (In Russian).

The determination of the relative ionization cross section by the mass spectrometric method was examined. In the method an intense molecular beam, guaranteeing during condensation a quantity of material ample for chemical analysis, is used. Data on the composition of the condensate were used in the calculation of the relative cross section. The ratios of the ionization cross sections of the vapor over CdTe and CdSe and the ratios of the ionization cross sections of dimers and monomers of Te and Se were determined. (tr-auth)

Nuclear Spectroscopic Instrumentation

43076 (AAEC/TM-458) THE ANALYSIS OF Ge(Li) GAMMA RAY SPECTRA WITH AN ON-LINE COMPUTER. Allen, B. J.; Upex, G. D.; Trimble, G. D. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). June 1968. 19p. Dep.

The application of a small on-line computer to data-taking and analysis of Ge(Li) gamma ray spectra is described. Both symbolic and FORTRAN programs are included and the merits of on-line analysis discussed. (auth)

43077 (ORNL-4153) MEASUREMENT OF CLINICAL RADIOACTIVITY. Ross, D. A.; Harris, C. C. (Oak Ridge National Lab., Tenn.). Feb. 1968. Contract W-7405-eng-26. 51p. Dep. CFSTI.

A discussion is presented that is intended to help doctors and technicians understand what a pulse-height spectrometer is, what it can do, and what it should not be expected to do. It offers the operator: a means of finding out, easily, which γ energies the instrument is counting, and the privilege of adjusting the energy pass band to suit the counting problem at hand; relative freedom from errors due to uncontrolled scattered radiation; an improved signal-to-background ratio, since much of the background is out of sight; improved stability, when the instrument is operated correctly; greater freedom in using two nuclides together, since the instrument can, within limits, pick out the characteristic radiations individually; and a powerful analytical tool that can check the radiochemical purity of supplied material, or establish the identity of an unknown emitter, by revealing the γ-ray spectrum. These advantages become available only at a price. A spectrometer is more expensive than an ordinary threshold scaler, which, in effect, has a window sill but no window top; there are more components in a spectrometer to get out of order, and it requires careful and informed operation. (E.R.B.)

43078 OBTENTION PROCESSES OF TEMPORAL INFORMATION IN A Ge(Li) DIODE: APPLICATION TO γ SPECTROMETRY. Ostertag, E.; Miehe, J. A.; Coche, A. (Nuclear Research Center, Strasbourg). Onde Elec., 48: 583-7(June 1968). (In French).

The time at which a γ particle is detected by a Ge(Li) semiconductor counter can be derived either from its current pulse or its integrated charge pulse. A Ge (Li) - Ge (Li) coincidence arrangement is described. The coincidence γ-ray spectrum of ^{60}Co obtained in one detector, when the other is gated on the 1,333 keV full energy peak and when the coincidence resolving time is equal to 30 ns, has a threshold of 150 keV. (auth)

43079 CONTROL CIRCUIT FOR WILSON CHAMBERS. Kogut, Yu. P. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 7: 67-75 (1967). (In Russian).

A circuit for a semiconductor device used in the automatic control of Wilson chambers for the registration of high-energy cosmic particles was described. A block diagram of the installation, its operational sequence, and the principal circuits of separate junctions were given. A cycle generator and binary counter were used as transducer of time intervals. This made it possible to obtain both small (millisecond) and large (minute) time intervals with a sufficient degree of precision. The circuit developed can be used to control Wilson chambers with any parameters during study of cosmic particles with energy of 3×10^{13} eV. (tr-auth)

43080 GAMMA-RAY ASSAY OF ^{238}Pu IN WASTE DRUMS. Strohm, W. W. (Mound Lab., Miamisburg, Ohio). Nucl. Appl., 5: 183-9(Sept. 1968).

Plutonium-238 in contaminated trash and equipment contained in steel drums was determined by measuring, with a NaI(Tl) detector, the intensity of the 765-keV gamma ray from the decay of plutonium-238. By gamma-ray stripping, the contributions of higher energy gamma rays to the 765-keV gamma-ray photoelectric peak could be subtracted, despite the large amount of scattering material present in the drum. The transmission of the 765-keV gamma ray inside the drum was determined by measuring the transmission through the drum of the 765-keV gamma ray from external plutonium-238 standard sources. The uncertainty in the measurements is ±28% at the 95% confidence level when the drum contains $\geq$0.180 g of plutonium-238. (auth)

43081 A ROTATING DISC SPECTROMETER FOR OBSERVATION OF THE MOESSBAUER EFFECT. Fay, C. W.; McAulay, I. R. (Trinity Coll., Dublin). Sci. Proc. Roy. Dublin Soc., Ser. A, 3: 115-24(1968).

A full description is given of the constructional details of a rotating disc Moessbauer spectrometer. The drive mechanism and the electronic equipment used are discussed, and techniques developed for the preparation of large area absorbers are given. The factors which affect the velocity resolution are considered and evaluated for the instrument described. Some experimental results are presented and compared with theory. An assessment of the advantages and disadvantages of the instrument is included. (auth) (UK)

43082 CALIBRATION CURVES FOR THE GAMMA-GAMMA PROBES. Umiatowski, Krzysztof (Instytut Techniki Jadrowej, Krakow). Nukleonika, 13: 413-19(1968). (In Polish).

The effect of the collimation of the source and the discrimination energy on the calibration curve for the gamma-gamma probes are discussed on the basis of theoretical calculations by the Monte-Carlo method. The calibration curves are established for three energies of the source, 1.25 MeV, 0.66 MeV, and 0.28 MeV. The rules for recalculating these curves for different source energies are given. In the cases for which experimental data were available, the experimental results are compared with the theoretical ones and good agreement is found to exist. (auth)

43083 APPARATUS FOR THE LUNA-10 AUTOMATIC STATION FOR INVESTIGATION OF THE GAMMA RADIATION OF LUNAR ROCKS. Egiazarov, B. G.; Kononov, B. N.; Kurochkin, S. S.; Surkov, Yu. A.; Shekhovtsov, N. A. Kosm. Issled., 6: 265-72(Mar.-Apr. 1968). (In Russian).

A scintillation γ spectrometer, installed in the Luna-10 automatic station, is described. For elimination of the background of charged particles in the spectrometer, a laminated phosphor, NaI(Tl) crystal, with dimension ϕ 28 × 38 mm was used in the container of scintillating plastic. The amplitude analyzer of the spectrometer has 32 channels with capacity up to 4096 pulses. The mean dead time of the analyzer is less than 600 μsec, the non-linearity of the scale does not exceed 1%, and the non-uniformity of the width of the channel is no more than 2%. The energy range of the spectrometer is from 0.3 to 3 MeV or from 0.15 to 1.5 MeV. The weight of the spectrometer is 4.5 kg and the input is 2.5 W. Methods for the calibration and gaging of the device are reported. (tr-auth)

43084 MULTICHANNEL AMPLITUDE ANALYZER FOR COSMIC INVESTIGATION. Kononov, B. N.; Myasnikova, L. N.; Rakcheev, V. P.; Glushkovskii, M. E. Kosm. Issled., 6: 273-85(Mar.-Apr. 1968). (In Russian).

A 32-channel amplitude analyzer for investigations of cosmic radiation is described. The analyzer was installed in the γ spectrometer complex of the Luna-10 automatic station. The capacity of one channel is 4096 pulses, the non-linearity of the scale (integral) does not exceed 1%, and the non-uniformity of the channel width (differential non-linearity) is not more than 2%, and the mean dead time is near 550 μsec. The collection of the spectra is discontinued during saturation of any channel. The time of measurement is fixed in the timer channel. The weight of the device is 3.9 kg and the input is 2.5 W. (tr-auth)

43085 PRELIMINARY RESULTS ON TIME-OF-FLIGHT MEASUREMENT OF PHOTOFISSION FRAGMENTS AT HIGH

ENERGIES. Sonoda, Masateru; Katase, Akira (Kyushu Univ., Fukuoka). Genshikaku Kenkyu, 13: 1-12(June 1968). (In Japanese).

In order to measure the mass and energy distributions for photofission fragments, a time-of-flight apparatus was developed, using a PDP-5 computer on-line. Such a system is found to operate satisfactorily, if background problems are solved. Preliminary results show that a single peaked and nearly symmetric distribution is found for fragment-velocity distribution in fission induced by high energy photons. (auth) (NSA of Japan)

43086 ON A SPECIAL APPLICATION OF CORRELATION METHODS IN NEUTRON SPECTROSCOPY. Skoeld, K. (Argonne National Lab., Ill.). Nucl. Instrum. Methods, 63: 347-8(Aug. 15, 1968).

The application of a correlation-type spin-flip chopper to the measurement of polarization dependent scattering of thermal neutrons is proposed. (auth)

43087 ACCURACY OF POLARIZED NEUTRON SPECTROMETER OPERATING WITH SCATTERING VECTORS NOT NORMAL TO THE DIRECTION OF THE MAGNETIC FIELD. Delapalme, A.; Georges, R.; Schweizer, J. (CEN, Grenoble, France. CNRS, Grenoble, France). Nucl. Instrum. Methods, 63: 283-4(Aug. 15, 1968).

The accuracy of a polarized neutron spectrometer is studied for scattering vectors not normal to the direction of the applied magnetic field. Two sources of error in the relative ratio of the magnetic and nuclear scattering amplitudes are examined: the errors due to the counting statistics and to the misadjustment of the sample. (auth)

43088 SIMULTANEOUS ANALYSIS OF CORRELATED XY EVENTS AND SINGLE X AND Y EVENTS BY SAMPLING. Muser, A.; Zen, J.; Michaud, J. D.; Scheibling, F. (Institut de Recherches Nucleaires, Strasbourg). Nucl. Instrum. Methods, 63: 263-8 (Aug. 15, 1968). (In French).

In a bidimensional analysis it is often necessary to know together with the XY spectrum the two single X and Y spectra. It is important to use the same converters for both types of spectra. The resulting increase of the dead time may be limited using a sampling method. A first method is based on a cyclic time chopping, a second one on the counting of the events. The latter needs special electronic circuitry whose logic is described. (auth)

43089 RAPID DETERMINATION OF ^{235}U/^{238}U RATIOS BY ACTIVATION ANALYSIS UTILIZING HIGH RESOLUTION GAMMA SPECTROMETRY. Turkstra, J.; Steyn, W. M.; De Wet, W. J. (Atomic Energy Board, Pretoria). Nucl. Instrum. Methods, 63: 269-73(Aug. 15, 1968).

High resolution γ-spectrometry was applied for the direct determination of the ^{235}U/^{238}U isotopic ratios of small uranium samples after neutron activation and allowing a fixed cooling time of one hour. The consistency obtained relative to the mass spectrometric analysis is about 5% for isotopic ratios between 0.06885 and 1.095, and about 6% if the natural uranium abundance is included. For high enrichments (93% ^{235}U), the consistency is only approximately 20%. The precision obtained was well below 3% for most of the isotopic ratios investigated. (auth)

43090 PILE-UP DETECTION CIRCUIT. Gracovetsky, S.; Loude, J.-F. (Univ., Lausanne, Switzerland). Nucl. Instrum. Methods, 63: 349-50(Aug. 15, 1968).

A pile-up detection circuit using mostly linear and logical integrated circuits is described. It is operated from the output of a double delay line clipped amplifier. (auth)

43091 STATISTICAL ANALYSIS OF A CROSS-CORRELATION CHOPPER FOR TIME-OF-FLIGHT MEASUREMENTS. Virjo, A. (Technical Univ., Helsinki). Nucl. Instrum. Methods, 63: 351-2(Aug. 15, 1968).

The statistical accuracy of a cross-correlation type time-of-flight measurement using pseudo-random modulation of the chopper is discussed and compared with the accuracy of a corresponding conventional arrangement. The results can be applied to other similar cross-correlation measurements as well. (auth)

43092 VACUUM CHAMBER INVESTIGATION OF LOW ENERGY ELECTRONS LIBERATED BY X RAYS. Greening, J. R.; Randle, K. J. (Univ. of Edinburgh). Brit. J. Radiol., 41: 534-44(July 1968).

A parallel-plate vacuum chamber is described and the theory of its use as an electron energy spectrometer is given. The spectra of low-energy (up to about 10 eV) electrons both liberated within and emitted from sheets of copper, aluminium and graphite irradiated by 250 kV x rays, are derived under various assumptions of angular distribution. The total emission of low-energy electrons is found to be 1.63, 1.74, and 1.28 Coulombs per rad cm^2 for copper, aluminium, and graphite respectively, when irradiated by x rays having energies, based on HVT's in copper, ranging from 60 to 156 keV. Comparison is made with values of energy dissipation density derived from secondary electron emission studies. An explanation is advanced to account for the negative slope of the current-voltage characteristic of the spectrometer and similar devices at high bias voltages. (auth)

43093 HIGH-RESOLUTION MAGNETIC BETA-RAY SPECTROMETER. Gelberg, A.; Ringhiopol, I.; Protop, C.; Vita, I.; Tripa, C. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 13: 375-8(1968).

A preliminary report is given on the construction and performance of a Kelman-type, high-resolution beta spectrometer. The spectrometer is intended for high-resolution conversion electron measurements. The design, the field distribution of the lens, and the current for the K line of ^{137}Cs, and the K line of ^{198}Au are shown. The resolution shown for each line is 0.05 and 0.056% respectively, and the ultimate aim for the resolution is 0.02%. (J.F.P.)

43094 SYSTEM FOR THE STABILIZATION OF A TIME-OF-FLIGHT SPECTROMETER OF THE NANOSECOND RANGE. Lapshin, V. G.; Omel'yanenko, M. N.; Rykalin, V. I.; Sinaev, A. N.; Khromov, V. P.; Tsisek, Z. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 3, 44-51(May-June 1968). (In Russian).

A system for the stabilization of a nanosecond time-of-flight spectrometer using two marked intervals of the time between flashes of light from semiconductor pulse sources, which make it possible to stabilize the threshold and the transfer coefficient, was described. The stabilization system encompasses all tracks of the spectrometer from the photomultiplier tubes up to the input of the memory installation. Because of the use of the stabilization system, the long-term stability of the position of the center of gravity of the measured time distribution is $\pm 3 \times 10^{-12}$ sec. (tr-auth)

43095 PULSE STRETCHER FOR SPECTROMETER WITH SEMICONDUCTOR DETECTOR. Efimchik, M. K.; Protasevich, M. Z.; Chernyavskii, A. F. (Belorussian State Univ., Minsk). Prib. Tekh. Eksp., No. 3, 66-8(May-June 1968). (In Russian).

A pulse stretcher constructed on the basis of the amplitude of the input pulse on a capacitor and subsequent deduction of the fixed charge by means of a direct current generator was described. The pulse stretcher threshold assigns the size of the discharge current at a fixed time duration and is established with a precision not less than 0.1%. The circuit operates in the input signal range up to 11 W and was designed for work with spectrometric amplitude analyzers. (tr-auth)

43096 LINEAR AMPLIFIER FOR SPECTROMETER WITH SEMICONDUCTOR DETECTORS. Podol'nyi, E. I. (Belorussian State Univ., Minsk). Prib. Tekh. Eksp., No. 3, 105-6 (May-June 1968). (In Russian).

A linear amplifier circuit having high linearity in all dynamic ranges was described. The amplification coefficient of the tricascade circuit is $K = 4000$ with natural rise time $\ll 0.3\ \mu$sec. The noise level at the input is $\approx 40\ \mu$V. The circuit retains its characteristics in the temperature range from 10 to 50°C. (tr-auth)

43097 ANALYSIS OF X-RAY SPECTRA OF ELEMENTS WITH ADJACENT ATOMIC NUMBERS BY THE EMISSION PEAKS. Plotnikov, R. I.; Zakasozskii, G. V.; Goganov, D. A.; Pshenichnyi, G. A.; Ochkur, A. P. Prib. Tekh. Eksp., No. 3, 185-7(May-June 1968). (In Russian).

A substantial improvement in the energy resolution of proportional counters by operation at the emission peaks was described. The method makes it possible to resolve K_α peaks of some neighboring elements. For many elements it is possible to resolve the K_α and K_β lines with respect to the peaks. This effect can be used in the crystalless x-ray spectral analysis for the resolution of the characteristic radiation of elements with adjacent atomic numbers. (tr-auth)

High Energy Physics Instrumentation

Refer also to abstracts 44297 and 44300.

43098 (CERN-68-26) WIRE SPARK CHAMBER PULSING SYSTEM WITH FOUR THYRATRONS. Andersson, G. Lennart (European Organization for Nuclear Research, Geneva (Switzerland)). July 12, 1968. 15p. Dep.

In order to generate HV pulses for wire spark chambers with magnetic core read-out, a system with four hydrogen thyratrons of the tetrode type has been developed and built. It gives negative pulses with a maximum amplitude of 5 kV and nominally 170 nsec length into eight 8 Ω loads. The rise-time of the pulse is typically of the order of 20 nsec, and the total delay, measured from the trigger pulse input, is 85 nsec. Power consumption and dissipation limits the pulse repetition frequency to 1 kHz at 10% duty cycle. (auth)

43099 ANALYSIS OF NEGATIVES OF BUBBLE CHAMBERS. Nuttall, Jacques (CERN, Geneva). Onde Elec., 48: 588-94 (June 1968). (In French).

A project is described which was carried out at the NPA division of CERN, Geneva, in which analysis tables of photographs of bubble chambers were compared on a CDC 3,100 computer. The way in which research is pursued at CERN and abroad is delineated. (auth)

43100 CERTAIN CHARACTERISTICS PROPERTIES ASSOCIATED WITH CLOUD CHAMBER EXPANSIONS. Haque, Bazlul (Univ. of Dacca, Pakistan). J. Natur. Sci. Math., 7: 121-42(Oct. 1967).

A further study of the characteristics of cloud chamber expansions and of track growths in the chamber was conducted. The chamber had a long sensitive time and the process of multiple photography per expansion was adopted. Of the total expansions 40% were found to be free from background effect. On the whole, conditions were attained in such a way as to record a background level two orders of magnitude lower than attained before. Detailed explanations of the importance of long sensitive time and of very low background level are given. Discussions are made of the factors which limit the useful portion of the sensitive time per expansion. The basic factors for selecting those photographic records which may clearly indicate the presence of an interesting low-ionizing particle are emphasized. Curves showing track-load track droplet density, and background density, all against the expansion time are shown. Discussions are also given showing clear distinction between different classes of chamber expansions. (auth)

43101 NEW METHOD PROPOSED FOR THE STUDY OF INCLINED TRACKS IN NUCLEAR EMULSIONS. Simonin-Haudecoeur, Christiane; Schune-Boisble, Denise (Faculte des Sciences, Paris). Compt. Rend., Ser. A and B, 266: 1337-40(May 13, 1968). (In French).

Projections of tracks inclined on two planes, one perpendicular to the line joining the two extremities O and A of the track, and the other perpendicular to the track and containing OA, make it possible to determine the behavior of the track in the emulsion after treatment and in favorable conditions to effect multiple scattering measurements. (tr-auth)

43102 DELTA ELECTRONS IN HYDROGEN BUBBLE CHAMBERS. Boos, E. G.; San'ko, L. A.; Takibaev, Zh. S.; Temiraliev, T.; Khomenko, K. I. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 7: 89-99(1967). (In Russian).

The density of δ electrons, necessary for identification of charged particles in liquid hydrogen, was evaluated. Formulas were derived for the probable identification of particles, on whose tracks δ electrons were not detected. The residual range–energy ratio was calculated for electrons in liquid hydrogen in a wide energy range. This ratio is well approximated by a linear dependence in the pulse interval from 1 to 100 MeV/c. Since for electrons the ionization and radiation losses are substantial, the approximations of the tracks in the chamber were obtained by means of the trajectory calculated considering this dependence. A clear form of the trajectory and obtained and calculated formulas were derived for the determination of its parameters from the direct measurement of the coordinates of the electron tracks in the bubble chamber. (tr-auth)

43103 BRAD: THE BROOKHAVEN RASTER DISPLAY. Ophir, D.; Rankowitz, S.; Shepherd, B. J.; Spinrad, R. J. (Brookhaven National Lab., Upton, N. Y.). Commun. ACM (Ass. Comput. Mach.), 11: 415-16(June 1968).

A multiconsole computer display system for bubble chamber film analysis is described which can plot tens of thousands of points, or up to 4000 characters at 30 frames per second. The technique employed is that of programmatically generating a binary image of the desired display in a computer. A standard television monitor serves as the display device. (W.H.K.)

43104 COUNTER CONTROL SYSTEM FOR HIGH-ENERGY EXPERIMENTS. Pozar, F.; Kajikawa, R. (Deutsches Elektronen-Synchrotron, Hamburg). Nucl. Instrum. Methods, 63: 325-8(Aug. 15, 1968).

An analog and time control system for a great number of counters is presented in which light diodes are used. The main feature of the system is that the light source attached to the counters is fired by only one pulse generator, with the time relations simulated to resemble high-energy particle passages. On-line analog control is effected by pulse height analysis of the photomultiplier output. (auth)

43105 PASSIVE READOUT TECHNIQUE FOR SPARK-DISCHARGE COUNTERS. Huetter, G. Th.; Madey, R.; Pomerleau, J. (Clarkson Coll. of Tech., Potsdam, N. Y.). Nucl. Instrum. Methods, 63: 337-8(Aug. 15, 1968).

A simple, reliable, passive readout technique for spark-discharge counters distinguishes between breakdown (or spark-discharge) events and non-breakdown events on the basis of differences in the time durations of the signals at the high-voltage electrode of the spark-discharge counter. (auth)

43106 IMPORTANCE OF SPARK CHAMBERS. Elsner, B. (Deutsches Elektronen-Synchrotron, Hamburg). Naturwissenschaften, 55: 193-7(May 1968). (In German).

The construction of a spark chamber is illustrated; its different properties are described. The application of spark chambers and their advantages and disadvantages as particle detectors are discussed. (J.S.R.)

43107 READ-OUT SYSTEM WITH DIRECT SELECTION OF INFORMATION FROM WIRE SPARK CHAMBERS. Babaev, A. I.; Belov, A. F.; Ermilov, A. I.; Kurochkin, S. S. Prib. Tekh. Eksp., No. 3, 75-7(May-June 1968). (In Russian).

A read-out system was described designed for the memory of the information input with ferrite rings of the wire spark chamber parallel at all compartments of the register and its outlet subsequently to the coder. During data output the conversion was controlled only at those compartments in which information was contained. The signal transfer time for questions to compartments with no data was ~50 nsec. The register operates reliably from pulses with amplitude of ~2v and duration of ~0.3 μsec. (tr-auth)

Radiation Dosimeters

Refer also to abstract 43050.

43108 (IFA-PN-19) PERSONAL DOSIMETER FOR NEUTRONS. Nicolae, M.; Pop, R. (Academia R. P. R., Bucharest. Institutul de Fizica Atomica). 1968. 20p. Dep.

The complex dosimeter for neutrons described allows measurement, using a single badge, the exposure dose due to thermal neutrons, gamma rays, and fast neutron. It may be manufactured for two conditions. The first one for current exposure doses (10^{-6} rem – 10^{2} rem) the second one for both current and accidental exposures (10 rem to 10^{4} rem). (auth)

43109 (TID-24609) FAST NEUTRON DOSIMETRY OF ^{252}Cf. Oliver, George Davis Jr. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). 1968. 75p. Dep. CFSTI. Thesis. Submitted to Univ. of Oklahoma, Norman.

An investigation to describe the fast neutron dose rate in millirad per hour around a linear californium-252 source in a simulated tissue environment using a practical dosimetry system is described. Two methods of measurement were used to determine the dose rate decrease with increasing tissue depth: silicon diode dosimeters and activation threshold foils. Also, the diode dosimeters were used to measure the fast neutron dose distribution in a single plane around the californium-252 source. Based on this distribution, an isodose chart was established. This investigation is aimed toward the practical use of californium-252 for radiotherapy. (W.H.K.)

43110 IMPROVEMENTS IN OR RELATING TO MEASURING DEVICES FOR THERMOLUMINESCENT DOSIMETRY. (to Societe Anonyme, Mfg. Belge de Lampes et de Materiel Electronique, M.B.L.E.). British Patent 1,118,250. June 26, 1968. Priority date Sept. 16, 1965, Belgium.

An apparatus for measuring the light emitted from a thermoluminescent dosimeter is described. The apparatus consists of a receptacle for the dosimeter, a photosensitive element, and a body of material transparent to light encircling the radiation-sensitive element. The transparent material has an internally reflecting outer surface except for a portion for transmitting the emitted light to the photosensitive element. (W.H.K.)

43111 IMPROVEMENTS IN OR RELATING TO THERMOLUMINESCENT DOSIMETERS. (to Societe Anonyme, Mfg. Belge de Lampes et de Materiel Electronique, M.B.L.E.). British Patent 1,121,452. July 31, 1968. Priority date Jan. 29, 1965, Belgium.

A thermoluminescent dosimeter and heating system is described such that the thermoluminescent material is divided into two parts which may be heated at two different rates. Additional information concerning measured radiation dose may be obtained using the system. (W.H.K.)

43112 RUBY FLUORESCENCE AS A DOSIMETER FOR PULSED, HIGH ENERGY, IONIZING RADIATION. Halpin, J. J.; Wenzel, R. F. (Naval Research Lab., Washington, D. C.). Rev. Sci. Instrum., 39: 1117-19(Aug. 1968).

A convenient dosimeter for pulsed beams of high energy, ionizing radiation, of duration 300 μsec or less, is described. This dosimeter employs the R line (6943−6929 Å) fluorescence produced by ionizing radiation in low chromium concentration ($\sim$0.001%) ruby single crystals. The fluorescent intensity of ruby is linear with dose where the dose delivered per pulse is as much as 10^5 rad (ruby). The advantages of this dosimeter are that the value for the integrated dose may be obtained immediately from suitable detection and recording devices, the dosimeter is reuseable without any treatment for cumulative doses up to 10^8 rad (ruby), and the dosimetric measurement can be made at a time sufficiently beyond the radiation pulse so as to avoid the radiation-induced detector noise. (auth)

43113 RELATIVE SENSITIVITIES OF THERMOLUMINESCENT PHOSPHORS. Spurny, Z. D. (Nuclear Research Inst., Prague). Phys. Med. Biol., 13: 465-6(July 1968).

Problems in the use of TLD thermoluminescent dosemeters are briefly discussed, including wavelength dependence, light emission spectrum, glow maxima, dose sensitivity, etc. The sensitivity can be defined in terms of luminescence light yield per gram of material and per rad of absorbed radiation energy, and only this parameter can provide a satisfactory basis for relative comparison of TLD phosphors. Data are tabulated on the sensitivity of the following phosphors: LiF-200-s, LiF-N, $Li_2B_4O_7$ (Mn), Al_2O_3 (Cr), glasses, CaF_2 (nat.), CaF_2 (Mn), $CaSO_4$ (Mn), and $CaSO_4$(Sm). Cobalt-60 was employed for the irradiations. (UK)

43114 FLUENCE OF LOW-ENERGY ELECTRONS ESTABLISHED WITHIN AND EMITTED FROM IRRADIATED CONDUCTING MATERIALS. Burlin, T. E.; Husain, S. R. (Regent Polytechnic, London). Phys. Med. Biol., 13: 347-58(July 1968).

A parallel-plate vacuum chamber was used to measure the low energy electron fluence emitted from and established within irradiated materials. The variation of the electron fluence with photon energy and atomic number of the material was studied and implications for dosimetry are discussed. The low energy electron fluence within soft tissues irradiated by photons is estimated as 4×10^6 electrons cm^{-2} sec^{-1}. (auth) (UK)

43115 LIMITATIONS IN LOW RADIATION DOSE MEASUREMENTS USING THERMOLUMINESCENCE. Jones, D.; Bjarngard, B. E. (Isotopes Inc., Cambridge, Mass.). Phys. Med. Biol., 13: 461-4(July 1968).

Comments are made on the paper by Burch (Phys. Med. Biol. 12: 523(1967)) on the above subject. A reply by Burch is also given. (UK)

43116 EFFECT OF PARTICLE SIZE ON THE THERMOLUMINESCENCE OF LITHIUM FLUORIDE. Zanelli, G. D. (General Infirmary, Leeds, Eng.). Phys. Med. Biol., 13: 393-9(July 1968).

The variation with particle size of the luminescence efficiency of LiF exposed to monochromatic x-rays and γ-rays was studied. The efficiency was found to decrease considerably with particle size, and the magnitude of the effect was found to depend on the photon energy. The effect could, among other factors, be due to an inactive surface layer. (auth)

43117 IDENTIFICATION BADGE DOSIMETER. Brady, William J.; Iverson, Garn K. (to United States Atomic Energy Commission). U. S. Patent 3,393,318. July 16, 1968. Filed Feb. 23, 1966.

A film badge and credential holder for determining radiation exposure of a person subjected to different types of radiation is described. A first film sensitive to beta rays, gamma rays, x-rays, and thermal neutrons is superimposed over a portion of a second film sensitive to fast neutrons such that both films have outlying portions beyond the extremities of the other. The outlying portions of the first film are disposed intermediate several pairs of radiation filters for affecting individual types of radiation such that the nature of radiation exposure may be discerned, and means for detecting high radiation exposure exceeding film saturation are provided. (auth)

43118 PHYSICAL BASES AND METHODS FOR MEASUREMENT OF THE DOSE RATE OF PHOTON, ELECTRON, AND NEUTRON RADIATIONS. Huebner, Walter (Physikalisch-Technische Bundesanstalt, Brunswick). At. Strom., 14: 53-60(Apr.-May 1968). (In German).

After explaining the concept dosimetry the definitions of the following physical quantities and their units are explained: energy imparted to matter, kerma, absorbed dose, ion dose (equilibrium ion dose and cavity ion dose) equivalent dose, flux density and fluence. The relations between the different dose quantities for one thing and between absorbed dose rate, particle flux density or energy flux density and the corresponding interaction coefficients for another are specified, likewise the conditions for secondary particle equilibrium, for equivalence of matter and for the application of the Bragg-Gray relation are given. Finally the dose measuring methods used for protection purposes and the different points of view for their selection are explained. (auth)

43119 NEUTRON DETECTOR FOR MEASURING DOSE RATE. Splichal, William F. Jr. (to United States Atomic Energy Commission). U. S. Patent 3,398,278. Aug. 20, 1968.

A neutron detector for neutron dose measurement is described. A cylindrical mass of neutron moderator material is used which has a generally conical cavity in contact with a scintillation material. The cavity and scintillation material is in mating relationship with a generally conical light pipe. The light pipe base is in contact with a photomultiplier tube and a suitable photomultiplier circuit. The conical cavity shape is such that a higher proportion of faster entering neutrons are permitted to reach the vicinity of the scintillation material with sufficient energy to produce a quantity of recoil protons that is proportional to equivalent neutron dose in biological tissue. (AEC)

43120 AUTOMATIC ISODOSE PLOTTER USING FILM DOSIMETRY SYSTEM. Shigematsu, Yasushi (Osaka Univ.) Makino, Sumio. Nippon Igaku Hoshasen Gakkai Zasshi, 28: 125-33(May 1968). (In Japanese).

An automatic densitometer was recently designed and built for practical radiotherapy, in Osaka University Hospital, in collaboration with the Tokyo Shibaura Electric Co., Ltd. The densitometer has an integrated system composed of densitometer, film scanner, and color print-out system. A study was made to evaluate the accuracy and practicality of the densitometer and to examine the problems in film dosimetry. Discussions were made from the practical point of view, i.e., in the choice of film, and in the problems of calibration, etc. (auth) (NSA of Japan)

43121 GLASS MATERIALS FOR SILVER-ACTIVATED PHOSPHATE GLASS DOSIMETER. (to Tokyo Shibaura Electric Co., Ltd.). British Patent 1,124,917. Aug. 21, 1968. Priority date May 12, 1965, Japan.

Various mixtures are described for personnel badge dosimeters and military and civilian defense dosimeters. The mixtures comprise various compositions by weight of lithium metaphosphates, aluminum metaphosphates, and silver metaphosphates. Mixtures are also described for dosimeters used in radiology or radiotherapy. These comprise magnesium metaphosphates, lithium metaphosphates, aluminum metaphosphates, and beryllium metaphosphates. (B.G.D.)

43122 IMPROVED DOSIMETER. Bryer, Robert George (to R. A. Stephen and Co., Ltd.). British Patent 1,124,786. Aug. 21, 1968. Filed Dec. 1, 1964.

A dosimeter of the electroscope type with a detachable optical system for accurately determining the position of its moving member is described. (B.G.D.)

43123 IMPROVED SPHERICAL DOSE EQUIVALENT NEUTRON DETECTOR. Leake, J. W. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Instrum. Methods, 63: 329-32(Aug. 15, 1968).

Improvements have been made to the spherical neutron detector. The scintillation detector used in the earlier spherical moderator assembly has been replaced by a small spherical proportional counter, filled with ^{3}He gas, and this improves the gamma rejection properties, particularly at the higher gamma energies ($E_\gamma >$ 3.5 MeV) where the earlier detector was particularly sensitive. The new detector has a neutron/gamma ratio better than 1000 : 1 for a range of gamma energies from 0 to at least 7 MeV. The neutron/gamma ratio of all neutron detectors employing polyethylene (or paraffin wax) as a moderator is shown to be limited by the onset of (γ,n) reactions in the moderator at high gamma energies. The neutron sensitivity and the neutron energy response of the complete detector assembly have also been improved so that with a calibration figure of 8 cps = 2.5 mrem/h the detector matches the ICRP (1963) recommendations within a factor of 2 (+100%−50%) from 0.025 eV to 7 MeV. The total weight is unchanged at 5 kg (11 lbs.). The new detector is used in the Harwell monitor 0075 which has a total weight, including batteries, of 6.6 kg. (auth)

43124 MEGARAD DOSIMETRY TECHNIQUES USED AT THE CERN PROTON SYNCHROTRON. Madsen, J. H. B.; Van de

Voorde, M. H. (CERN, Geneva). Nucl. Instrum. Methods, 63: 274-8(Aug. 15, 1968).

A description is given of the various dosimetry techniques used at the CERN Proton Synchrotron for studying radiation damage to organic materials. The merits of the dosimeters are discussed and it is shown why the glass dosimeter was selected for routine measurements in the accelerator. Some results of radiation dose measurements are presented and radiation damage problems created by the doses found are mentioned. (auth)

43125 PHOTOGRAPHIC DOSIMETER FOR MEASURING THERMAL NEUTRONS. Pop, Rodica (Inst. of Atomic Physics, Bucharest). Stud. Ceret. Fiz., 20: 191-201(1968). (In Rumanian).

The structure and characteristics of a photographic dosimeter for the purpose of measuring thermal neutrons in the presence of gamma radiation are discussed. The principle of its use lies in the photographic action of gamma rays emitted in the reaction ^{113}Cd(n,γ)^{114}Cd. This dosimeter includes a filter of Cd – 0.7/Pb – 0.3 mm as a measuring filter, and a filter of Sn – 0.7/Pb – 0.3 mm as a comparison filter. In using the pair of films ORWO 3 + 4, one can measure the neutron doses in the interval from 30 mR to 100 R which corresponds to flux integrals from $3(10)^7$ to $1(10)^{12}$ neutrons per cm^2. (tr-auth)

43126 DEVELOPMENT OF SCINTILLATION AND IONIZATION METHODS IN RADIOMETRY AND DOSIMETRY. Arsaev, M. I.; Matveev, V. V.; Mysev, I. P.; Rudakova, G. M.; Samoilov, P. S.; Sulimova, N. E.; Uskov, V. S. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr., No. 1, 5-13(1964). (In Russian).

The major objectives of modern radiometry and dosimetry are discussed. These include the quantitative and qualitative analyses of radiation fluxes, the measurement of one type of radiation against the background of the others, the dosimetry of the soft and of the hard bremsstrahlung of accelerators and of impulse radiation fluxes, and the radiometry of low-energy beta rays in liquids and in gases. It is noted that one of the main trends in the development of radiometry and dosimetry is that of methods of scintillation measurement, on the basis of which a whole series of instruments for industrial use has been produced. Nevertheless, the use of ionization methods is more rational for certain dosimetric and radiometric tasks. A brief review of some modern instruments and equipment used to solve practical problems in radiometry and dosimetry is presented. (ATD)

43127 DOSIMETRY OF ^{60}Co γ-RAYS BY A SIMPLE CALORIMETRIC METHOD. Busulini, L. (Univ. of Padua); Cescon, P.; Lora, S.; Palma, G. Int. J. Appl. Radiat. Isotop., 19: 657-62 (Aug. 1968). (In French).

A simple and rapid calorimetric method was devised to determine the energy absorbed by a substance submitted to Co-60 γ-rays during the initial period where the energy absorption can be assumed to occur in adiabatic conditions. The dose-rate values obtained with water, benzene and mercury were found to be in good agreement with the corresponding values determined by means of the Fricke dosimeter. (auth) (UK)

43128 THERMOLUMINESCENCE DOSIMETRY WITH NATURAL CALCIUM FLUORIDE POWDER. Nambi, K. S. V.; Sunta, C. M. (Bhabha Atomic Research Centre, Bombay). Indian J. Pure Appl. Phys., 6: 294-8(June 1968).

The development of a radiation dosimeter using the thermoluminescent property of natural calcium fluoride is described. The dosimeter consists of a kanthal strip on which a thin layer of thermoluminescent calcium fluoride is deposited by means of a resin. It is heated by passing 30 A of current through the kanthal strip for half a minute and the thermoluminescence glow emitted is a measure of the radiation exposure received by the dosimeter. A photomultiplier tube coupled with an electrometer d.c. amplifier and recorder is used to measure and record the glow peaks. At Trombay this natural calcium fluoride thermoluminescence dosimetry system is being used for a number of purposes such as mapping of the radiation fields inside gamma garden, exposure measurements from irradiated reactor fuel, dosimetry in seed irradiation experiments and in personnel dosimetry. Some results of these applications are presented. (auth)

43129 NATIONAL PHYSICAL LABORATORY, TEDDINGTON, ENGLAND. REPORT FOR 1967. London, Her Majesty's Stationery Office, 1968. 235p. 24s.

A summary is included of the work of the Division of Radiation Science, covering X-ray dosimetry, chemical and solid state dosimetry, β-ray dosimetry, neutron cross-section measurements, thermal neutron flux density standards, fast neutron flux standards miscellaneous radioactivity measurements, radiocarbon dating, etc. (U.K.)

43130 PHYSICAL ASPECTS OF IRRADIATION. PART I. Kernenergie, Beil., 11: B243-60(Apr. 1968). (In German).

A report from the International Commission for Radiological Units and Measurements is presented. The report is concerned with the physical aspects of radiation and contains new data available since the report published in 1959. It gives an extensive discussion of the methods available for the measurement of the energy dose and ion dose. The characteristics of radiation measurement devices especially some remarks on standards are reported. The section on spectra was reworked and the spectra for neutron measurements and standards are introduced. The available data on the stopping power ratio and the mean energy expenditure W for the formation of an ion pair in a gas were tested. As a result of these tests it was necessary to modify these factors from the previously published values in ICRU tables. The stopping power ratios were modified by 1 to 2% and W by up to 1%. (tr-auth)

Radiometric Instruments

Refer also to abstracts 43011, 43070, and 44559.

43131 (COO-1239-16) POLYCHROMATIC AND MONOCHROMATIC X-RAY ABSORPTIOMETRY USING BETA EXCITED, ELECTRON CAPTURE AND OTHER ISOTOPIC X-RAY SOURCES. Final Report, September 1, 1965–July 14, 1966. Preuss, Luther E.; Toothacker, William S.; Bugenis, Claudius K. (Edsel B. Ford Inst. for Medical Research, Detroit, Mich. Div. of Nuclear Spectroscopy and Radiation Physics). May 1968. Contract AT-(11-1)-1239. 61p. Dep. CFSTI.

Solution absorptiometry was studied with x rays from beta excited x-ray sources. Since beta excited x-ray sources produce a bremsstrahlung continuum as well as the characteristic (monochromatic) x-rays of the beta absorber, the effective value of the absorption coefficient decreases with increasing amounts of absorbing material, due to a hardening of the continuum. Hence a graphing of ln I_0/I versus concentration of solute (the slope representing the sensitivity of the absorptiometry process) provides a nonlinear plot; where I_0 is the intensity of x rays after they have traversed the sample cell and solvent; I is the intensity after passing through cell, solvent, and solute. A study of this typical polychromatic absorption technique and also two methods in which only the K doublet energy is employed in the absorption process are discussed. By these two techniques, a straight line plot of ln I_0/I versus solute concentration, as is characteristic of monochromatic absorptiometry, is achieved. (auth)

43132 (STL-539-0001) EXPLORATORY DEVELOPMENT OF THE ρV PROPELLANT GAUGE. Final Report. Kaminskas, R. A. (TRW Systems Group, Redondo Beach, Calif.). Mar. 1968. Contract AT(04-3)-539. 66p. Dep. CFSTI.

The results of a feasibility study of two versions of an improved mass balance propellant gaging system for use under zero-gravity conditions are described. The technique is an improvement on the traditional PVT gaging system since pressure and temperature measurements are replaced with a direct pressurizing-gas density measurement using a beta ray absorption technique. This system results in a more accurate propellant gauge than the PVT gauge and is competitive in power and weight requirements. The first version, called the ρV gage, uses beta attenuation to measure the gas density in the pressurant tank. The second version called the RHO gauge, incorporates the ρV gage principle in both the propellant and pressurant tanks. In addition, an x-ray absorption technique is used in the propellant tank to measure and correct for the partial pressure of the propellant vapor. The beta-attenuation technique of the ρV gage was shown to be capable of measuring gas density within 0.1 percent. A breadboard test of the ρV system using water to simulate a low vapor pressure propellant demonstrated a propellant volume gaging accuracy of better than 0.2 percent. The x-ray attenuation technique of the RHO gauge was shown to be capable of measuring gas composition within 1.0 percent. Based on these results, a complete RHO system could be expected to gage storable propellants such as N_2O_4 and aerozine-50 in a bladderless tank within an accuracy of 1.0 percent. (auth)

43133 PROCESS AND APPARATUS FOR CONTROLLING THE AMOUNT OF SUBSTANCES DEPOSITED ON TEXTILES OR THE LIKE. (to Kyoto Kikai Kabushiki Kaisha). British Patent 1,123,045. Aug. 7, 1968. Priority date Sept. 3, 1964, Japan.

A process using radiometric instruments is presented for controlling the amounts of a liquid deposited on a flexible absorbent sheet or strip. In the process, the sheet is passed between a first radiation source and a first ionization chamber, the liquid is deposited on the sheet, and the sheet is passed between rollers to remove excess liquid and then passed between a second radiation source and a second ionization chamber. The two ionization chambers have the same output and performance characteristics, and a differential signal is derived from the chambers and used to adjust the pressure of the rollers. (D.L.C.)

43134 DESIGN OF A PULSED NEUTRON SOURCE AND BORE-HOLE FAST NEUTRON GENERATOR. Bobrowski, Czeslaw; Chrusciel, Edward; Dabek, Tadeusz; Korbel, Kazimierz; Massalski, Jerzy; Owsiak, Tadeusz; Studnicki, Julian (Instytut Techniki Jadrowej, Krakow). Nukleonika, 13: 371-82(1968). (In Polish).

A portable neutron generator is described. The pulsed operation of the neutron tube is controlled by means of magnetic elements. The portable neutron generator is located inside a steel tube 1000 mm long and 100 mm in diameter. The neutron yield during continuous operation of the device is about 10^8 n/sec. A prototype of a bore-hole neutron generator is also described. The bore-hole probe is provided with a pulse neutron source, detectors of secondary radiation, circuit for transmitting information from the probe to the surface apparatus, and a special circuit for synchronizing the work of the neutron tube with the surface apparatus. The surface electronic equipment measures the time distribution of gamma-quanta due to the radiation capture. (auth)

43135 RADIOGRAPHIC PROBE FOR DETERMINING THE DIRECTION OF GROUND WATER FILTRATION IN DRILL HOLES. Niemczynowicz, Janusz; Padzik, Andrzej; Fraczek, Edward (Przedsiebiorstwo Hydrogeologiczne, Warsaw). Nukleonika, 13: 461-4(1968). (In Polish).

A new probe for determining the direction of ground water filtration in drill holes by ionizing radiation detection is described. An x-ray film plays the part of a detector in this probe. Experiments on hydrogeological models have been carried out to select the optimum operating parameters for the probe and to compare the results obtained with the radiographic probe with those obtained with a slot probe. (auth)

43136 GEOPHYSICAL RADIOMETRIC INSTRUMENTS DESIGNED AND PRODUCED BY THE GEOPHYSICAL COMPANY FOR OIL INDUSTRY IN KRAKOW. Orczyk, Krzysztof (Przedsiebiorstwo Geofizyki Przemyslu Naftowego, Krakow). Nukleonika, 13: 495-501(1968). (In Polish).

The conditions of use of radiometric well logging instruments and the methods eliminating the defects due to these conditions are discussed. The newest geophysical radiometric instruments, signed and produced by the Geophysical Company for Oil Industry in Kraków are also described. (auth)

43137 ISOTOPE-POWERED X-RAY INSTRUMENT FOR DETECTING THE ARRIVAL ON AN INTERFACE IN A PIPELINE. Olson, Donald M. (to United States Atomic Energy Commission). U. S. Patent 3,396,272. Aug. 6, 1968.

The detection of the arrival of an interface in a pipeline with an X-ray generator-detector system in which is deposited on the concave surface of a copper reflection target is discussed. A very thin copper foil and Lucite filter are positioned between the ^{147}Pm and a beryllium window, and a collimator between the filter and the window. (AEC)

43138 OPTIMAL CONFIGURATION FOR A ZERO-G NUCLEONIC FUEL GAGE. Pfeifer, Robert J. (Industrial Nucleonics Corp., Columbus, Ohio). Contract NAS8-21014. J. Spacecraft Rockets, 5: 985-7(Aug. 1968).

A computer-aided simulation of liquid orientations within spacecraft tanks at zero-g permitted effective modification of source-detector configurations for gaging techniques based on stratified sampling schemes. The results of over 200,000 simultations indicate that approximately 15 sampling strata are required to provide maximum relative errors of less than 2% of the tank volume. (auth)

43139 INVESTIGATION OF WELLS BY THE γ SCATTERING METHOD WITH VARIOUS ISOTOPES. Meszaros, F. Magy. Geofiz., 9: 69-79(1968). (In Hungarian).

It was confirmed that the accuracy of the density determinations carried out on the basis of γ-γ measurements depends sharply on the density of the stone. In the density range from 1 to 3 g/cm^3 the determination accuracy varies between 0.01 and 0.15 g/cm^3. In order to investigate the chemical composition of the layers drilled, an isotope of lower energy must be used. The relation between the various heavy elements of the stone and the energy region of the γ scattering beam was tested by model measurements. The studies made establish that the resolution capacity of the well measurement device can be improved with increase in energy. (tr-auth)

43140 RADIATION MEASUREMENT INSTRUMENT HAVING STABILIZATION MEANS. Harwick, Burton T. (to North American Rockwell Corp.). U. S. Patent 3,393,313. July 16, 1968. Filed June 1, 1964.

The design of a scintillation detector and associated circuitry with increased accuracy and reliability is presented. A standard radioactive source is incorporated, and a feedback control system is designed for automatic calibration of the detector. The system is specifically designed for use as a radiometric liquid fuel gage for aircraft. (W.H.K.)

43141 IDENTIFYING FLYING CRAFT. Foster, George B. (to Industrial Nucleonics Corp.). U. S. Patent 3,390,849. July 2, 1968. Filed Jan. 8, 1965.

A method by which a launched vehicle can positively identify a friendly or unfriendly aircraft and a control system for a guidance avoidance system if the aircraft is found friendly are described. The method consists of depositing radioisotopes with coded radiations on friendly craft and a detection system for the launched aircraft for identifying the coded radiations. (W.H.K.)

43142 POSSIBILITY OF USING SPECTRAL DISTRIBUTION OF INVERSE SCATTERING γ RADIATION IN γ-THICKNESS GAUGE. Serebrennikov, I. Ya. Defecktoskopiya, No. 3, 14-16 (1968). (In Russian).

The feasibility of using the spectral distribution of backward-scattered γ radiation as a thickness gage is studied. The instrument spectrum is divided into two parts proportional to the intensity of multiscattered radiation (soft component) and single-scattered radiation (hard component). The ratio of these spectral components can be used in the thickness-gage studies. (R.V.J.)

43143 FUELLSTANDMESSUNG DURCH RADIOISOTOPE BEIM THERMISCHEN CRACKEN. (Filling Measurement with Radioisotopes in Thermal Cracking). Wieczorek, H.; Erhardt, H. Informationsheft des Buero Eurisotop, 13. Serie: Fallstudien 3. Brussels, Buero Eurisotop - Euratom, 1965. 10p. 1 DM.

The petroleum cracking installation, operating by the Dubbs method, is briefly described and the importance of level measurements in the coke chamber is stressed. A method for measurement of the coke level using radioisotopes is outlined. The engineering and cost aspects of the method are compared with classical methods. (J.S.R.)

43144 FUELLSTANDREGELUNG DURCH RADIOISOTOPE BEI DER MINERALWOLLE-ERZEUGUNG. (Filling Control with Radioisotopes in Mineral Wool Production). Wieczorek, H.; Erhardt, H. Informationsheft des Buero Eurisotop, 10. Serie: Fallstudien 2. Brussels, Buero Eurisotop - Euratom, 1967. 24p.

The production of mineral wool is described and the importance of filling measurements in the fusion chamber is discussed. The techniques for filling measurements using radioisotopes are described. An engineering and cost comparison of the radioisotope method is made with conventional methods. (J.S.R.)

43145 FEUCHTEMESSUNG MIT NEUTRONEN. (Moisture Measurements with Neutrons). Trost, A. Informationsheft des Buero Eurisotop, 12. Serie: Monographien 3. Brussels, Buero Eurisotop - Euratom, 1966. 50p.

Conventional methods for the measurement of moisture are briefly reviewed. The principles of nuclear moisture measurements are outlined. The neutron sources, detectors, probe devices, and electronic devices of moisture measurement apparatus are described. The application of neutron moisture measurements to glass sand, casting sand, sintering mixtures, cokes and coal, preparation of concrete and limestone and soil studies is discussed. The radiation protection precautions necessary are described. (J.S.R.)

43146 ON THE UNIFORMITY OF THE INDUSTRIAL LEAD FOIL SCREEN AND THE X-RAY FILM. Furuta, Junichiro; Hiraoka, Eiichi; Kanazawa, Tamotsu. Annu. Rep. Radiat. Center Osaka Prefect., 8: 92-4(1967).

The thicknesses of industrial lead foil screens and the silver content in industrial x-ray film were measured by the x-ray absorption method using characteristic x-rays from molybdenum and antimony. The procedure and results are presented. Large amounts of irregularity were found in both distributions. (auth)

Miscellaneous Instruments and Components

Refer also to abstracts 43895 and 43896.

43147 (AE-323) NOISE IN THE MEASUREMENT OF LIGHT WITH PHOTOMULTIPLIERS. Robben, F. (Aktiebolaget Atomenergi, Stockholm (Sweden)). May 1968. 73p. Dep.

In order to be able to compare measurements derived from the anode current of a photomultiplier with measurement derived from photoelectron pulse counting, a systematic investigation of the properties of some photomultiplier tubes has been made.

This has led to a correlation of the properties of a photomultiplier based on the quantum efficiency η, the gain G, a photoelectron loss factor S and an effective dark rate D. In terms of these quantities the signal to noise ratio of an experimental measurement can be calculated, given the light flux and measurement technique. The fluctuations in a photomultiplier output are divided into two parts; Poisson fluctuations, and those due to excess noise. It is experimentally shown, from measurements on a 931A photomultiplier, that the excess noise exceeds the Poisson fluctuations only at very low frequences, or long DC measurement times (>10 s), for both pulse counting and anode current measurements. The Poisson fluctuations are found to be approximately the same for both pulse counting and anode current measurements, at both high light levels where the dark current, or dark pulses, are negligible, as well as at low light levels where the dark current is dominant. The excess noise is found to be somewhat greater in the case of anode current measurements. Thus both pulse counting and anode current measurement techniques have nearly identical noise properties, as far as the photomultiplier is concerned, and selection of either experimental technique depends primarly on the properties of the electronic equipment. By use of a synchronous detection technique, the variance of the pulse count was measured experimentally to an accuracy of ±4%, and was shown to be in agreement with that predicted by Poisson statistics. (auth)

43148 (BNWL-SA-1976) SPECTRAL DATA HANDLING SYSTEMS. Brauer, F. P.; Schlosser, J. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). July 11, 1968. Contract AT(45-1)-1830. 10p. (CONF-681003-1). Dep. CFSTI.

From International Conference on Modern Trends in Activation Analysis, Gaithersburg, Md.

Computer systems for handling, analyzing, storing, and retrieving gamma spectroscopy data for neutron activation analysis are described. The systems are in FORTRAN IV for an IBM 7090 and a Univac 1108. (W.H.K.)

43149 (CEA-R-3445) THEORY AND TECHNIQUE OF SPARK SOURCE MASS SPECTROMETRY. Stefani, Rene (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Apr. 1968. 65p. (In French). Dep.

Trace analysis in solids by spark source mass spectrometry involves complicated phenomena such as element ionization in the spark and blackening of sensitive emulsion by the focused ion beam. However, the principal risk of selectivity lies in the analyser system, which realizes double focusing only for a part of the ions. Therefore, each analyst has to know the ionic optics of his apparatus, for ensuring the transmission of mean energetic ions, which are representative of the sample composition. By a careful photometry of mass spectrum, good reproducibility can be obtained. Therefore, accuracy depends on the knowledge of sensitivity coefficients proper to each apparatus. (auth)

43150 (FEI-112) DEVICE FOR AUTOMATIC READOUT AND PUNCHING OF EXPERIMENTAL DATA. Bobkov, V. P.; Ibragimov, M. Kh.; Papovyants, A. K. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1967. 10p. (In Russian). Dep.

A description is given of a device designed for automatic readout of information from an experimental stand and for converting it to a form suitable for a universal computer. The electrical signals of the measured parameters are connected one after another to an amplifier by a scanning device and enter next the input of an electronic digital voltmeter equipped with a printing accessory. The signals converted into binary-decimal code are punched on cards and used in this manner for further processing in a universal computer. The described device is constructed from standard devices. (auth)

43151 (FOA-4-4361-23) HIGH-PRESSURE CELL FOR SIMULTANEOUS ELECTRICAL RESISTANCE MEASUREMENTS ON TWO SAMPLES IN SEPARATE CIRCUITS. Leman, G. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). June 1968. 17p. Dep.

A high-pressure resistance cell for the simultaneous measurements on two samples in separate electrical circuits is presented. The cell is of the Drickamer type with supported anvils, and a method to insert a second circuit is described. The presence of this circuit is shown not to influence the relation between sample pressure and load. The determination of high pressures is discussed, and it is suggested that the method presented can simplify the calibration especially in the very-high-pressure region. The use of two samples in separate circuits instead of their series connection is shown to bring two advantages: the simultaneous investigation of substances with very different resistances, and the simultaneous study of phase transitions occurring at almost the same pressure. Various applications of the two-circuit method are illustrated by studies of phase transitions in Bi, Fe, Pb, CdS and Ti. (auth) (Swed)

43152 (INR-900) STATISTICAL ANALYSIS OF THE METHOD OF PAIR-SELECTION IN CONTENT ADDRESSABLE SYSTEMS. Hoffman, Zbigniew (Institute of Nuclear Research, Warsaw (Poland)). 1966. 66p. Dep.

Thesis.

In multiparameter experiments content addressable systems offer a much better utilization of memory space than a conventional multiparameter analyzer. Also, in many cases the number of channels in a content addressable system is not sufficient. Input data must be selected to collect a sample of descriptors. The collection of the sample of useful information based on the principle of pair-selection is analysed. The theory of this method for discrete and continuous distribution of input information is given. Several examples with simplified distribution of descriptors are solved. The theory of sliding-pair selection and its modification is introduced and analyzed. Statistical analysis of the filling-time of a store-sample is given and the comparison of the filling-time of a store-sample for pair-selection and first come, first served selection is made. Several practical applications of pair-selection are proposed and discussed. (auth)

43153 (IPP-1/73) SIGNAL GENERATOR FOR TESTING OSCILLOSCOPE ACCURACY. Ulrich, M. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Dec. 1967. 12p. (In German). Dep.

An electronic instrument is described here which was built for the easy checking of the accuracy and linearity of oscilloscopes. The test signal allows simultaneous checking of: timebase calibration and timebase linearity, calibration of vertical deflection sensitivity and vertical deflection linearity, focus and astigmatism setting, and beam brightness and triggering level for negative-going signals. One of the major advantages is that the output of the generator can be easily fitted to any setting of the oscilloscope, sensitivity as well as timebase. Thus the setting of the oscilloscopes ready for measurements on an experiment needs not to be changed for the checking procedure. Just the signal cable has to be replaced by the cable of the test-signal generator. The fact that the test signal is similar to a stair-step function allows the registration of all checks by taking one polaroid picture of a single display of the test signal on the oscilloscope screen. (auth)

43154 (IPP-3/71) A METHOD TO INCREASE THE TRANSMITTED LIGHT OF THE FABRY-PEROT INTERFEROMETER. Buechl, K. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Mar. 1968. 25p. (In German). Dep.

In a Fabry-Perot interferometer the intensity of the transmitted light is small relative to that of the incident light. A method is described which produces an increase by a factor of two in the transmitted light. To a close approximation the image of the light source is not affected. To employ this method the light must be polarized and the plasma gradients small. (auth)

43155 (LA-3916) AN INVESTIGATION OF A BUBBLER TRITIUM SAMPLER. Valentine, Allen M. (Los Alamos Scientific Lab., N. Mex.). Apr. 1968. Contract W-7405-eng-48. 11p. Dep. CFSTI.

Investigation of a bubbler tritium sampler indicated collection characteristics similar to reported human body uptake rates for tritium gas and tritiated water vapor. The bubble collector consisted of a dry gas wash bottle with a fritted glass tip on the inlet and distilled water as the collecting medium. Tests were made under both laboratory and field conditions, and the effects of varying the flow rate, water volume, and water temperature were determined. A flow-through ionization chamber instrument was used to measure the tritium concentrations sampled, and the collected tritium was determined by liquid scintillation counting. The observed collection efficiency for tritiated water vapor was >90% for sampling rates from 8 to 10 lpm, water temperatures from 25 to 35°C, and water volumes from 30 to 50 cc. Tritium gas was collected with an efficiency of <0.01% with the same sampling rates and water volumes but with a water temperature of 18°C. (auth)

43156 (NYO-3715-3) ULTRA HIGH VACUUM HIGH ENERGY ELECTRON DIFFRACTION CAMERA. Vook, Richard W.; Portanova, Robert J. (Syracuse Univ. Research Inst., N. Y. Dept. of Chemical Engineering and Metallurgy). July 1968. 56p. Dep. CFSTI.

An ultra high vacuum high energy electron diffraction camera, presently operating up to 50 keV, has been developed. The design, construction, and operational features of this instrument are described in the present report. This instrument was designed for use in studying clean and selectively contaminated surfaces and the nucleation and growth of thin films on these surfaces. Clean surfaces may be obtained in situ in the instrument by heating the sample with an electron beam heater or by argon ion bombardment followed by high temperature annealing. The ability to attain ultra high vacuum is essential in the study of clean surfaces in order to prevent the formation of contamination layers in unreasonably short times. At 10^{-10} Torr, a few hours are required to form a monolayer. Means for producing a controlled atmosphere and measuring its components were incorporated into the instrument. The low penetration power of electrons makes electron diffraction a very useful tool for surface studies. Although low energy electron diffraction (LEED) is predominantly used, the instrument described below was designed primarily for reflection high energy electron diffraction (RHEED). RHEED is not only as sensitive as LEED, but can be used to detect a lower degree of ordering. The latter fact has been applied to studies of oxidation, submicroscopic faceting, and amorphous and polycrystalline films. At present, structure data are obtained from a diffraction pattern which is displayed on a fluorescent screen. Future plans include a Faraday cage to be used for truly quantitative intensity measurements. Such measurements will yield much additional information on crystal imperfections in surface layers. (auth)

43157 (ORNL-TM-2032) CLOSED-CIRCUIT TELEVISION VIEWING IN MAINTENANCE OF RADIOACTIVE SYSTEMS AT ORNL. Moore, R. L. (Oak Ridge National Lab., Tenn.). Nov. 1, 1967. Contract W-7405-eng-26. 13p. (CONF-661001-58). Dep. CFSTI.

From 14th Conference on Remote Systems and Technology, Pittsburgh, Pa.

Considerations affecting the use of closed-circuit television in radioactive systems are discussed. Equipment used for closed-circuit television viewing at the Homogeneous Reactor Test and at the Molten-Salt Reactor Experiment is described. The results of a radiation test of a miniature, radiation-resistant television camera are presented. (auth)

43158 (SC-CR-68-3625) OPTIMAL FEEDBACK CONTROL OF THE RADIOACTIVE VOLTAGE STANDARD. Braudaway, David William (New Mexico Univ., Albuquerque. Bureau of Engineering Research). Mar. 1968. Contract AT(29-1)-789. 147p. Dep. CFSTI.

Thesis.

For Sandia Corp., Albuquerque, N. Mex.

A two-limb calorimeter is used to produce a reference voltage. Heat flow in each limb produces a temperature rise across the limb air gaps. In one limb, the temperature rise caused by the radioactive source is sampled by a pair of temperature-sensitive resistors. In the other limb, a second pair of resistors samples the temperature rise caused by the resistive heater. These four-temperature-sensing resistors are connected to form a bridge which is balanced when the heat outputs of the sources are matched. While the bridge output is a measure of system response and power balance, the output voltage is produced by a sampling resistor connected in series with the heater. Because the thermal time constants of the system are long, automatic control of the balanced condition is desired. A mathematical model of the system behavior is given. Analysis of the bridge characteristics and the limb thermal behavior leads to linear-approximation models for each of these subsystems. The characteristics of a galvanometer-amplifier are also discussed. By careful selection of these characteristics, a system is produced in which Brownian noise effects and response effects of the galvanometer are negligible. From this analysis the system is modeled by a linear second-order equation. System operation is evaluated in terms of a quadratic performance index for each of two criteria. The primary criterion is employed when use of the system output is necessary. Under this criterion the two power levels must be held in balance and the rate of change of heater current must be minimized. When the system output is not used, the secondary criterion is employed in which weighting of the rate of change of heater current is reduced, producing a faster response. By use of the maximum principle a realizable optimal feedback control is developed for each of the two quadratic criteria. Use of optimization techniques assures that the produced voltage is nearly as predictable as is the radioactive source activity. (auth)

43159 (SC-M-68-125) COMMENTS ON FLASH PHOTOLYSIS AND TIME RESOLVED MASS SPECTROMETRY. Meyer, Richard T. (Sandia Corp., Albuquerque, N. Mex.). June 1968. 24p. Dep. CFSTI.

Information is presented on problems in instrumentation and kinetic analysis associated with flash photolysis studies by time resolved mass spectrometry. Topics included are flash lamp characteristics, electromagnetic interference, high pressure sampling, statistical fluctuations, transient species detection, and photolysis of NO_2, CO_2, and HCOOH. In addition, listings of papers on flash photolysis and time resolved mass spectrometry and laboratories engaged in time resolved mass spectrometry are included. (auth)

43160 MASS-SPEKTROMETRICHESKIE PRIBORY. (Mass-Spectrometers). Rafal'son, A. E.; Shereshevskii, A. M. Moscow, Atomizdat, 1968. 235p.

A short review is given of classifications, theory, and physical processes in mass spectrometers. Design, construction, and performance of various types of mass spectrometers are described and the vacuum, electron, and ion-optical systems used in mass spectrometers are analyzed. Static-type of mass spectrometers, dynamic omegatron, and time-of-flight mass spectrometers are described as will as leak detectors and isotope and molecular composition detectors. (R.V.J.)

43161 COUNTING DEVICES. Taylor, D. (Univ. of Strathclyde, Scotland). Meas. Instrum. Rev., 15: 428-33(June 1968).

Part I of survey series. Headings are as follows: Basic requirements; scales of notation; types of counters; electronic devices; applications; ionized particle counting; elapsed time determination; accuracy of measurements; counting-rate meters. (UK)

43162 COUNTING DEVICES. Taylor, Denis. Meas. Instrum. Rev., 15: 513-14(July 1968).

This is Part 2 of a three part survey, and gives brief specifications of electronic counters commercially available in UK. (UK)

43163 AN rf GATE WITH 140 dB CARRIER SUPPRESSION. Burnett, L. J.; Harmon, J. F. (Univ. of Wyoming, Laramie). Rev. Sci. Instrum., 39: 1226-7(Aug. 1968).

An rf gate which was developed for a 20 to 30 MHz pulsed NMR spectrometer is described. The gate delivers 40 V peak-to-peak rf pulses of 1 to 40 μsec duration. A signal generator capable of providing 0.5 V into a 50 Ω load is used to drive the rf gate. (W.H.K)

43164 DETECTOR FOR THE METASTABLE IONS OBSERVED IN THE MASS SPECTRA OF ORGANIC COMPOUNDS. Daly, N. R.; McCormick, A.; Powell, R. E. (Atomic Weapons Research Establishment, Aldermaston, Eng.). Rev. Sci. Instrum., 39: 1163-7(Aug. 1968).

A sensitive ion detector is described that can record the normal and metastable components of the mass spectrum of an organic compound. Alternately it can suppress to a very high degree the normal spectrum and amplify the metastable spectrum. It can detect metastable transitions taking place on either side of the magnet on a sector type mass spectrometer and it can be used to examine the different fragmentation pathways in the decomposition of an organic ion. The use of the device as an energy selector is briefly discussed. (auth)

43165 AIR ION APPARATUS. Bachman, C. H.; Crandell, M. E.; Hart, F. X. (Syracuse Univ., N. Y.). Rev. Sci. Instrum., 39: 1168-70(Aug. 1968).

An apparatus is described which produces a ducted flow of air or gas which contains a controlled unipolar ion concentration. Included are flow regulators and a filter system that passes only particles smaller than 0.05 μ. Ionization is produced by a radioactive source. Control of ion concentration is best achieved by diluting the ionized flow with nonionized gas which has bypassed the ionizing unit. Electrical methods of controlling ion levels have also been examined. Ion concentrations up to about 10^6 ions/cm^3 (1000 times ambient) are obtained with the radioactive sources presently in use. (auth)

43166 TIME TO AMPLITUDE CONVERTER FOR THE SUBNANOSECOND RANGE. Lan'ko, E. V.; Dombrovskaya, G. S. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 7: 45-8(1967). (In Russian).

A time-amplitude converter, based on the principle of overlapping of standardized pulses, entering with the photomultiplier anode, was described. The high frequency transistors A-418 were used in the converter. Stilbene crystals and the photomultiplier FEU-30 were used as detectors. Resolving times of 9×10^{-11} sec were obtained in self-coincidences from ^{60}Co sources during linearity ranges of 6×10^{-9} sec. For forming of the time pulses with respect to duration, a disconnect method was proposed on the cut edge of the coaxial cable installed in the cathode of the buffered cascade. (tr-auth)

43167 ON SCANNING ELECTRON DIFFRACTION. II. Grigson, C. W. B.; Tillett, P. I. (Cambridge Univ., Eng.). Int. J. Electron., 24: 101-38(Feb. 1968).

The design, advantages and applications of automatic electron diffractometers are discussed with reference to an improved system. The power to measure electron scattering profiles from which loss electrons are virtually eliminated is the fundamental difference between the new instruments and traditional photography of electron diffraction patterns. The basic limitations of the diffractometers are discussed. A new treatment of the electron gun is given, based on angular distributions of current which prove to be Gaussian. This treatment is necessary when maximum signal intensity is required. A number of improvements in electronic circuitry are described, which include servostabilization of the gun emission, automatic two-dimensional scanning, and control of CRT display brightness or of xy writing rate in accordance with the intensity of the peaks. The fields of application where the new diffractometers have advantages are when accurate (that is filtered) intensities must be determined, and when growing or changing specimens are studied. The applications are illustrated by the performance of the improved system, and the first measurements of two-dimensionally scanned growing films are presented. It is shown that the speed of the new instrument, both in producing growths and in recording them, is important for thin film studies. The speed is itself an aid to consistency, to effective improvement in vacuum conditions, and extensive tests for consistency become practicable while parameters of the specimen growth may be systematically varied. (auth)

43168 PROTON SCATTERING MICROSCOPE. Livesey, R. G.; Butcher, G. (Edwards High Vacuum International Ltd., Crawley, Eng.). J. Phys., E, 1: 820-1(1968).

Recent experiments on the interaction of proton beams with solids have shown that the regular variations of intensity in the spatial distribution of the scattered beam is dependent on the regular nature of the crystalline lattice. This has been exploited in an apparatus which may be applied to the orientation and examination of single crystals and thin crystalline films. In the proton scattering microscope described a beam of protons is directed on to the crystal under investigation and the scattered beam is observed directly on a fluorescent screen. (auth)

43169 LIQUID METAL MONITOR. Roach, Peter Francis; Davidson, Daniel Fraser (to United Kingdom Atomic Energy Authority). U. S. Patent 3,390,571. July 2, 1968. Priority date Oct. 26, 1964, Great Britain.

A liquid metal monitor for estimating an impurity in a liquid metal stream and having an orifice in a liquid metal flow path, which can be at least partly plugged by precipitate from liquid metal in the flow path is described. At the orifice, liquid metal flow is divided into two parts so that subsequently one of the parts passes through, and the other part by-passes the orifice. (auth)

43170 IMPROVEMENTS IN CONTINUOUS OXYGEN MONITOR FOR LIQUID METALS. (to United Nuclear Corp.). British Patent 1,120,350. July 17, 1968. Priority date July 15, 1966, United States.

A system which continuously monitors the oxygen content of liquid alkali metals by an electrolytic technique is described. The system measures the electromotive force generated by a galvanic cell, one electrode of which is the oxygen-containing liquid metal, the other electrode of which is a metal oxide or oxygen-containing metal having a known oxygen potential that is stable under the conditions encountered in the operation of the device, and the electrode of which is a solid metallic oxide that conducts electricity predominantly by the transfer or migration of oxygen ions. (W.H.K.)

43171 DEVICE FOR CONVERTING PHOTOGRAPHICALLY RECORDED DATA TO COMPUTER-COMPATIBLE MAGNETIC TAPE. Glass, Ian S.; Richard, Kenneth F. (Massachusetts Inst. of Tech., Cambridge). Rev. Sci. Instrum., 39: 1131-2 (Aug. 1968).

A machine for use in x-ray astronomy experiments for automatically transferring counting rate data in the form of dashed trails on photographic film to computer-compatible magnetic tape is described. To ensure accurate registration of the film, a servo-controlled corrector is incorporated. (auth)

43172 THE AEPIONICON: A NEW PENETRATING RADIATION IMAGING DEVICE. Jacobs, John E.; Kovac, Michael G. (Northwestern Univ., Evanston, Ill.). pp 63 of Proceedings of the 19th Conference on Engineering in Medicine and Biology, San Francisco, California, November 14-17, 1966. Volume 8. Vurek, Gerald G. (ed.). New York, Institute of Electrical and Electronics Engineers and Pittsburgh, Instrument Society of America, 1966.

See CONF-661119.

43173 THE SENSITIVITY OF THE IMAGE BRIGHTNESS INTENSIFIER OF X-RAY PICTURES OF THE RU-135 TYPE FOR THE DEVELOPMENT OF CALIBRATED DEFECTS. Alekseev, V. V.; Volkov, I. V.; Zhukov, V. B.; Zhurav, A. I.; Pol'skii, V. G.; Yakobson, A. M.; Yakushev, V. F. Defektoskopiya, No. 2, 70-4(1968). (In Russian).

The use of x-ray amplifiers of the RU-135 type for defectoscopy control in installations with x-ray devices with voltages up to 150 keV and current up to 10 mamp makes it possible to control the details from Al of thicknesses up to 100 mm and from steel up to 25 mm. The maximum sensitivity with very thick control objects is 2% for Al and 4% for steel. (tr-auth)

43174 APPARATUS FOR DELAYING A CONTINUOUS ELECTRICAL SIGNAL. Walker, Ray A. (to United States Atomic Energy Commission). U. S. Patent 3,399,386. Aug. 27, 1968.

A device for delaying an analog input signal is described. An analog-to-digital converter stores samples of the analog input signal in cyclically selected magnetic core memory storage locations after the previously stored samples therein have been read and transferred to a digital-to-analog converter. The output signal of the digital-to-analog converter is thus delayed from the analog input signal by the time required to cycle through all of the core memory storage locations. (AEC)

43175 TRANSDUCER FOR MEASUREMENT OF TRANSIENT VELOCITIES. Johnson, Keith O.; Robinson, Dan L. (to United States Atomic Energy Commission). U. S. Patent 3,398,572. Aug. 27, 1968.

An apparatus for measuring rapid transient velocities of liquids in a restricted passage from rest is described. The apparatus consists of a float having permanent magnets embedded in it and a rod wound with a series of coils of opposite polarity. The float is slidably mounted on the rod so that a rapid movement of the liquid will cause a corresponding movement of the float containing the magnets along the rod. The magnets induce an alternating electrical current in the coils. The frequency of the current is directly proportional to the transient velocity of the liquid. (AEC)

43176 FREQUENCY CONVERTER USING LARGE SIGNAL SQUARE-LAW SEMICONDUCTOR. Huen, Tony (to United States Atomic Energy Commission). U. S. Patent 3,398,297. Aug. 20, 1968.

This patent relates to a large signal square-law cadmium sulfide crystal diode frequency conversion circuit in which a large signal square-law transformation between a full-wave rectified sinusoidal signal and a pure sinusoidal signal yields frequency multiplication or division. (AEC)

43177 METHOD OF AND APPARATUS FOR MEASURING HIGH TEMPERATURES. Meier, Rolf (to EURATOM). British Patent 1,124,136. Aug. 21, 1968. Priority date Dec. 28, 1964, Germany.

A method is described for measuring high temperatures (200 to 1000°C). The method consists of placing a cold-worked electric-conducting wire in the region to be measured. The wire is then removed and then a concentrated temperature field at a predetermined temperature above the temperature being measured is traversed along the length of wire in the longitudinal direction at a predetermined speed, and at the same time the voltage between the ends of the wire is determined, which voltage is a measure of the temperature being measured. (B.G.D.)

43178 SELF-CALIBRATING LIQUID LEVEL MEASURING DEVICE. Dozer, Bill E. (to United States Atomic Energy Commission). U. S. Patent 3,398,578. Aug. 27, 1968.

A liquid-level-measuring device consisting of a coaxial transmission line probe is described. The probe is mounted with the longitudinal axis normal to the surface of the liquid and in contact with it. Means are provided for applying a pulsed electrical signal and to use the reflected signal to measure the level of the liquid. A number of elements are spatially disposed with respect to each other along the longitudinal axis to provide calibration marks. (AEC)

43179 APPARATUS FOR MEASURING SMALL QUANTITIES OF GAS, ESPECIALLY INERT GASES, BY MEANS OF GAS CHROMATOGRAPHY. Dubansky, Alois (to Ceskoslovenska Akademie Ved). British Patent 1,124,085. Aug. 21, 1968. Priority date Nov. 2, 1964, Czechoslovakia.

A device is described for measurement by gas chromatography of small quantities of argon liberated from solid materials by the application of heat, especially of ^{40}Ar which is contained in potassium minerals and which is formed by the natural decay of ^{40}K. (B.G.D.)

43180 MAGNETIC SWITCHING APPARATUS. (to Atomic Energy of Canada Ltd.). British Patent 1,120,140. July 17, 1968. Priority date Dec. 1, 1968, Canada.

A magnetic switching apparatus using magnetic reed contact devices and acting as limit switches is described. (B.G.D.)

43181 HIGH-SPEED ANALOGUE-TO-DIGITAL CONVERTERS IN NUCLEAR MEASURING TECHNIQUES. Tarnay, Katalin. Meres Automat., 13: 101-5(1965). (In Hungarian).

The high-speed analogue-to-digital converters of pulse-height analyzers employed in nuclear measuring techniques are discussed. Some conversion principles such as intermediate pulse-height-to-time transformation, servo-stabilized conversion, comparison with linear and nonlinear staircase voltage, transformation based on employing the vernier scale, and a conversion based on delay line coincidence are described in detail. (auth)

43182 ISOLATED-TUNNEL DIODE BINARY SCALER. Tan, Z. C. (Univ. of Auckland, New Zealand). Nucl. Instrum. Methods, 63: 333-6(Aug. 15, 1968).

A reliable binary scaler capable of operating at a maximum rate of 220 MHz is described. The basic R-S flip-flop consists of a tunnel diode which is isolated from the earth line by a common-base transistor and whose bias source is loaded by another transistor. Diodes are used to steer set and reset currents into the flip-flop and these gates can be triggered by a voltage of 0.5 V across a 50 ohm input terminating resistor. The duration of the input pulse has to be between 2 and 4 ns. A number of these scalers can be directly connected together to form ring counters. (auth)

43183 DERIVATIVE MEASUREMENT OF PHOTOMULTIPLIER RESPONSE. Bonazzola, G. C. (Univ., Turin. Istituto Nazionale di Fisica Nucleare, Turin); Chiavassa, E.; Maringelli, M. Nucl. Instrum. Methods, 63: 339-41(Aug. 15, 1968).

A method for obtaining a detailed analysis of the apparent response of a photocathode is proposed. This involves an application of the self-derivative method and gives the radial derivative of sensitivity experimentally. Three different photomultipliers have been analyzed; their characteristics have been tentatively described by means of the function $R(r) = \{S(r)\}^{-1}\, dS(r)/dr$, where $S(r)$ is the photomultiplier response as a function of the radius of the photocathode. (auth)

43184 STATISTICAL PROPERTIES OF THE SCALER RATEMETER COMBINATION. Parker, J. B.; Vincent, C. H. (United Kingdom Atomic Energy Authority, Aldermaston, Eng.). Nucl. Instrum. Methods, 63: 321-4(Aug. 15, 1968).

The statistical properties of the scaler ratemeter combination are studied with particular reference to determining any inferiority of the rate measurement in comparison with a direct ratemeter. The interest in such a combination arises, for example, from the possible use of a scaler to derandomize a random pulse train and to reduce the pulse rate sufficiently for recording on magnetic tape, for subsequent rate measurement on replay. The expected value and standard deviation of the reading are found and also the corresponding quantities for the difference between this reading and the reading of a direct ratemeter receiving exactly the same train of input pulses. Exact values are found and it is shown that under the conditions of main interest there is no appreciable inferiority in the rate measurement. (auth)

43185 AUTOMATIC PRESSURE-CONTROLLING DEVICE FOR HIGH-VACUUM APPARATUS. Annoni, S.; Salardi, G.; Verrazzani, L.; Uccelli, F. (Univ., Pisa, Italy). Nucl. Instrum. Methods, 63: 279-82(Aug. 15, 1968).

A device for the control of the vacuum degree in physical apparatuses is proposed, which incorporates a time delay that discriminates against fast random fluctuations of the vacuum. The device can be employed as a protection system in case of leakages of vacuum or for the programming of vacuum degree in dependence of some parameters (time, temperature, etc.). Circuit details and experimental results are reported. (auth)

43186 ALUMINUM ELECTROMAGNET OF LARGE WORKING VOLUME FOR PLASMA RESEARCH. Dzoanh, N. T. (Illinois Inst. of Tech., Chicago). Nucl. Instrum. Methods, 63: 317-20 (Aug. 15, 1968).

A very low cost electromagnet of about 28,000 cm^3 working volume with availability of port holes for plasma diagnostics at regular intervals was designed and constructed from flat aluminum conductors. A uniform axial field up to 3000 G, over a distance of 85 cm and an inside bore diameter of 20 cm can be obtained. The ripple of the axial field is well within $\pm 1/2\%$ of 1% required by the experiments. The field along an axis 8 cm off center varies less than ±2% from the central axis field. The air core electromagnet is in perfect working condition, and its physical characteristics such as field uniformity, field intensity and heating rate correspond exactly to the theoretical prediction within the experimental error. (auth)

43187 THREE-CHANNEL RADIOMETER FOR MEASURING THE POLARIZATION OF COSMIC RADIATION AT THE FREQUENCY 210 Mc. Kapustin, P. A.; Petrovskii, A. A.; Razin, V. A.; Sokolova, N. F. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 689-92(1968). (In Russian).

A modulation radiometer designed for investigating the polarization of distributed cosmic radiation is described. The radiometer allows the simultaneous registration of intensities with the average frequency of 210 MHz and spectrum widths of 1.2 to 17 MHz. A method for investigating the galaxy structure by comparison of the intensities of polarization signals with the different width of the frequency spectrum is briefly discussed. (auth)

43188 IMPROVEMENTS IN OR RELATING TO CODED INFORMATION ANALYSING ARRANGEMENTS. Cooke-Yarborough, Edmund Harry; Hickman, Stanley Alfred; Hooton, Ivor Noel; Prior, Gilbert Maurice (to Electric and Musical Industries Ltd.). British Patent 1,123,612. Aug. 14, 1968. Filed Aug. 20, 1964.

A coded information analyzing arrangement for analyzing incoming coded words is described. It consists of a store having a plurality of storage locations each able to store at least part of one incoming coded word, means for comparing each incoming word and for producing a signal indicative of the location if a match is obtained, writing means for writing the word into a vacant storage location and for producing a signal indicative of that location if a match is not obtained, and means for rejecting the word if all storage locations are filled. (W.H.K.)

43189 DEVICE FOR STAMPING AUTORADIOGRAPHIC FILMS. Gaedike, H.; Wagner, K. (Institut fuer Physikalische Chemie, Radionuklidlabor, Berlin). Isotopenpraxis, 4: 41(Jan. 1968). (In German).

A stamping device for autoradiographic films which numbers the films and also indicates the size of the preparation is briefly described. (J.S.R.)

43190 MILLION-CHANNEL SYSTEM FOR MEASUREMENT OF STATISTICAL DISTRIBUTION. Ofengenden, R. G.; Berezin, F. N.; Lapshuk, P. V.; Shchur, A. M. (Inst. of Physics, Kiev). Prib. Tekh. Eksp., No. 3, 68-75(May-June 1968). (In Russian).

A system was designed for the measurement of the multiple dimension distribution of pulse parameters by means of the associative selection of useful information. The automatic system was adapted for the accumulation of the most probable events. There are two memory installations, associative and periodic. The range of the measurement channels is 10^6 and the index number, by which information is accumulated, is 4096. The intensity of the input statistical pulses is 6000 pulses/sec with an error of 1%. The processing and output of the data are done simultaneously and are independent of the accumulation process. The data were developed on a cathode ray tube digital installation, perforator, and magnetic tape. (tr-auth)

43191 HIGH-EFFICIENT DYNAMIC QUADRUPOLE MASS SPECTROMETER. Slobodenyuk, G. I.; Titov, A. I.; Voronin, V. S.; Ivashkin, V. I. Prib. Tekh. Eksp., No. 3, 141-5(May-June 1968). (In Russian).

A highly efficient dynamic quadrupole mass spectrometer permitting the comparatively qualitative analysis of the composition of residual gases in vacuum systems in the pressure range from 10^{-3} to 10^{-7} torr was described. The analytical range of the device is from 1 to 150 atomic mass units. The resolution capacity is 1 atomic mass unit at registration rates of 200 pulses of mass spectrum in 1 sec and sensitivity with respect to Ar is 2×10^{-9} torr. The oscillograph Cl-19 is used as mass spectrum indicator. (tr-auth)

43192 HIGHLY TRANSMISSION ION SOURCE WITH ELECTRON BOMBARDMENT. Vasil'eva, N. K.; Gall, L. N.; Kleshkov, E. M.; Petrova, E. B.; Stepanova, M. S.; Fridlyanskii, G. V. (Design and Construction Bureau for Analytical Instrument Manufacture, Leningrad). Prib. Tekh. Eksp., No. 3, 154-7(May-June 1968). (In Russian).

A mass spectrometer gaseous ion source, characterized by simple construction and increased output, was described. The source does not have a natural magnetic field. At argon pressures in the ionization range 5×10^{-4} torr, the source guarantees at the input to the mass spectrometer analyzer an ion current of 7×10^{-7} A and at the collector a current of 1.2×10^{-7} A. (tr-auth)

43193 INTERMEDIATE INFORMATION STORAGE ON MAGNETIC TAPE, WORKING IN START–STOP REGIME. Asfendiarov, D. A.; Dobyrn, V. V.; Platunin, A. I.; Stabnikov, M. V. (Physical-Technical Inst., Leningrad). Prib. Tekh. Eksp., No. 3, 77-80 (May-June 1968). (In Russian).

An intermediate magnetic tape data storage was described. The entry was put on slowly moving tape (30 mm/sec) in the start-stop regime. The computation was made with continuously moving tapes with rate of 2000 mm/sec. The data were inscribed through two levels without pause. The volume of the information, inscribed on one tape, is equal to 6000 — 7000 36-discharge words in the binary code. (tr-auth)

43194 SYNCHRONOUS DETECTOR FOR NMR AND EPR SPECTROMETER. Volnyagin, D. P.; Grigor'ev, S. B. (Leningrad Electrotechnical Inst.). Prib. Tekh. Eksp., No. 3, 135-6 (May-June 1968). (In Russian).

A simple and reliable synchronous detector for NMR and EPR spectrometers was described. The presence of a limiting circuit, converting the sinusoidal voltage into rectangular makes it possible to realize the advantages connected with the use of carrier voltages of rectangular form and to increase the signal-noise ratio at the output of the synchronous detector. (tr-auth)

Radiation Effects on Instruments and Instrument Components

43195 EFFECT OF SOME FISSION FRAGMENTS ON THE OPERATION OF CESIUM DIODES. Bekmukhambetov, E. S.; Lebedev, S. Ya. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 7: 33-44(1967). (In Russian).

The results of the experimental investigation of cesium diodes with additions of inert gases at pressures of cesium and inert gases of 2.7×10^{-1} to 4 and 2.7×10^{-1} to 235 mm Hg respectively, and cathode temperatures of 1100 to 2100°K were reported. The experimental and theoretical values of the saturation current calculated by the diffusion theory were compared. The divergence of experimental and calculated values was explained by a possible mechanism of thermodiffusion separation of the mixture. The thermodiffusion ratios and interactions cross section of Cs with Kr and Xe were calculated from the experimental data. (tr-auth)

43196 PHOTOCONDUCTIVITY AND THERMALLY STIMULATED CURRENT OF ZnS AND CdS IRRADIATED WITH ELECTRONS. Shono, Yoshihiko; Kitagawa, Michiharu; Yoshida, Toshio. Annu. Rep. Radiat. Center Osaka Prefect., 8: 78-81(1967).

Photoconductivity (PC) and thermally stimulated current (TSC) of ultra high pure ZnS (ZnS-R), high pure ZnS (ZnS-P) and grade A CdS irradiated with electrons of 5 MeV were measured. PC of ZnS-R and CdS increased with electron bombardment while PC of ZnS-P decreased. The increase of PC of ZnS-R and CdS may be due to the increase of sensitizing centers while the decrease of PC of ZnS-P to the increase of recombination centers and scattering centers. The results of TSC measurements of ZnS-P indicate that the impurity centers responsible for TSC associate with defects produced by electron bombardment and form new centers. The results of TSC of CdS show that the centers giving the TSC about 170°K increase in number with electron bombardment. Annealing was observed at room temperature for CdS. (auth)

43197 DESIGN CONCEPTS OF A TRANSIENT SIGNAL RECORDER FOR OPERATION IN PULSED IONIZING RADIATION. Herickhoff, R. J.; Chaffin, J. H. (Sperry Rand Corp., St. Paul, Minn.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-15: No. 4, 21-6(Aug. 1968).

The feasibility of a recorder for measuring transient radiation effects, and which is radiation hardened so that it minimizes ionizing effects on the instrumentation itself, has been investigated by designing, fabricating, and testing a 10 channel analog sampling recorder which samples an input signal of ±6 mA at 100 MHz sampling rate for 100 ns period. The instantaneous sample values are stored as magnetic flux in successive thin magnetic films of a channel. Upon non-destructive readout of the thin films, a time amplitude reconstruction of the input signal is made to within ±15% of full scale. The system shows radiation hardness in excess of 10^{10} r/sec, except for the interface amplifier which is hard to 5×10^{8} r/sec. (auth)

43198 PULSIVE RADIATION-INDUCED CURRENT IN ELECTRIC INSULATORS. I. Okabe, Shigeru; Tsumori, Kunihiko; Tabata, Tatsuo; Kawabata, Keisuke; Nakamura, Shigeki; Yoshida, Toshio. Annu. Rep. Radiat. Center Osaka Prefect., 8: 55-9 (1967).

The radiation induced current (RIC) in several kinds of insulators was measured at the beginning of irradiation and its pulse shape was observed with an oscilloscope. The radiation used was produced by an 18-MeV electron linear accelerator. Variations of the RIC pulse shape with time and with temperature showed almost the same feature in some cases. The pulse shape was found to be dependent on direction of the crystal axis of the sample against the radiation. Discussions on the pulse shape, using the image of traps and positive holes, are presented. (auth)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

Refer also to abstracts 43037, 43038, 43300, 43305, 43313, 43314, 43353, 43356, 43375, 43389, 43391, 43396, 43397, 43431, 43436, 43441, 43442, 43444, 43455, 43456, 43469, 43473, 43475, 43480, 43488, and 44964.

43199 (ACRH–28, pp 47-55) STUDIES ON IMMUNOLOGIC UNRESPONSIVENESS DURING SECONDARY DISEASE. II. THE EFFECT OF ADDED DONOR AND HOST IMMUNOLOGICALLY COMPETENT CELLS. Thompson, J. S.; Simmons, E. L.; Moy, R. H.; Crawford, M. K. (Univ. of Chicago).

Normal host C3H/Anf lymphocytes or spleen cells (10×10^6) did not alter the progression of secondary disease or the ultimate survival of mice if administered 21 days after irradiation and allogeneic AKR bone marrow transplantation. Survival was enhanced by the injection of 50×10^6 normal C3H/Anf spleen cells (63%) and the survivors did not show signs of secondary disease. The effect of donor and spleen cells preimmunized one-to-the-other on the survival of the chimera was determined. When AKR anti-C3H/Anf spleen cells were injected, a sharp increase in mortality began 8 days after injection; C3H/Anf anti-AKR spleen cells also caused an early mortality. These survivors showed none of the signs of secondary disease. Third party 101 or C57/L cells immune to either donor or host were detrimental to chimera survival in all instances; the effect of 101 spleen cells was most marked. The study demonstrated that added host spleen cells may be beneficial 21 days after irradiation and that the effect was specific since third party cells were never efficacious. (B.S.L.)

43200 (AD–664651) EFFECT OF X-IRRADIATION ON THE RESPONSE OF HUMAN PERIPHERAL LYMPHOCYTES TO PHYTOHEMAGGLUTININ. Block, P. C.; Nachtwey, D. S. (Naval Radiological Defense Lab., San Francisco, Calif.). Dec. 18, 1967. 23p. (USNRDL-TR–67-155). CFSTI.

Cultures of human peripheral lymphocytes were irradiated at 100, 200, 400, and 800 R, and phytohemagglutinin added to induce DNA synthesis and mitosis. The ability of the irradiated cells to respond to phytohemagglutinin was determined at 44, 48, 68, and 72 hr after irradiation, using both morphologic criteria and autoradiography with tritium-labeled thymidine. At 44 hr after irradiation, cultures having received 100 R had an almost equal percentage of labeled cells (17%) as unirradiated control cultures. However, after exposures of 200, 400 and 800 R, the percentage of labeled cells dropped to 14.7, 9.3, and 5.2%, respectively. The same pattern of response was present at 48 hr after irradiation, although the total percentage of labeled cells was higher. A plot of labeled cells vs. radiation dose at 44 and 48 hr after irradiation showed a shoulder extending to 100 R and was consistent with an exponential survival curve in which increasing radiation produced a progressive diminution in the ability of the cells to respond to phytohemagglutinin. Despite the difficulty in extrapolating these results to the situation of in vivo radiation damage, it appears that the response of irradiated lymphocytes to phytohemagglutinin might be useful as a biological dosimeter. (auth) (USGRDR)

43201 (AD–664676) ELEVATED PLASMA DEOXYCYTIDINE LEVELS IN RATS: A BIOLOGIC DOSIMETER OF X RADIATION. Guri, Charles D.; Swingle, Karl F.; Cole, Leonard J.; Bailey, J. Stanley (Naval Radiological Defense Lab., San Francisco, Calif.). Feb. 9, 1968. 18p. (USNRDL-TR–67-153). CFSTI.

Deoxycytidine (CdR) was identified as the major deoxynucleoside present in normal rat blood plasma, at basal levels ranging from 5.2 to 7.8 micrograms/cc. The separation procedure involved charcoal absorption and paper chromatography (butanol-H^2O–NH^3 system), and quantitative estimation was carried out by the isotope dilute method employing CdR-2-^{14}C. Significant increases in plasma CdR levels (25–50% over normal) were observed two or three hr following exposures to 25 R, 33 R, and 50 R of whole-body x radiation. A curvilinear dose-response relationship was evident in the range of 50 R to 200 R, while the response was essentially flat between 200 R and 600 R. The significance of these findings as a basis for a biologic dosimeter for radiation exposure, is discussed. (USGRDR)

43202 (AD–666941) EFFECT OF GAMMA IRRADIATION ON SERUM ISOENZYME SYSTEMS. Final Report, May 1, 1966–April 30, 1967. Blair, William H. (IIT Research Inst., Chicago, Ill.). June 27, 1967. Contract AF41(609)-3135. 65p. (IITRI-L–6036-5). CFSTI.

The objective of this program was to study serum LDH isoenzyme alterations after subacute irradiation with primates. These alterations were related to dose in order to relate the minimum dose necessary to produce significant LDH isoenzyme changes. The doses studied were 200, 300, and 500 rads at a dose rate of 20 rads/min. Blood was collected, and the clear supernatent was analyzed by electrophoresis and histochemical staining for LDH isoenzymes. The isoenzyme change and the altered ratio were calculated and related to dose of irradiation received. It was established that the band 1-to-band 2 ratio should be 1.0-to-2.5. Values above or below this range were considered abnormal. Depression of the 1-to-2 ratio that lasted 72 hr was seen at four hr after irradiation in the 300- and the 500 rad groups. The ratio became markedly elevated to 4.2-to-1 in the 300-rad group at 168 hr. This elevation was not seen in the 200 rad group, whose ratio remained depressed throughout the test period. It appears that 200 rads is not the lower limit of radiation detected by serum LDH isoenzyme alterations but that lower levels may be detectable with these methods. (auth) (USGRDR)

43203 (BNL–12594) ANALYSIS IN TERMS OF CELLULAR PARAMETERS OF INTERANIMAL VARIATION OF HEMOPOIETIC RADIORESISTANCE. Robinson, C. V. (Brookhaven National Lab., Upton, N. Y.). [1967]. 18p. (CONF-680518–3). Dep. CFSTI.

From Conference on Comparative Cellular and Species Radiosensitivity in Animals, Kyoto, Japan.

A model of acute mammalian hemopoietic radiation mortality is formulated in such a way as to relate the dose-survival curve of a population of animals with that of its stem cells. First it is assumed than an individual will survive if he has a certain threshold number of effective mature cells, given by a threshold function referred to a specified time after irradiation. A random variable, the effective proliferation factor is then specified, that describes the proliferation initiated per stem cell. With the further assumption that stem-cell survival obeys Poisson statistics, the probability that an animal will survive any given dose is uniquely determined. This probability is found to give an approximately normal, S-shaped dose-survival curve, the mean dose and width of which are known functions of six stem-cell, and five additional, parameters. The width of the curve depends principally on: interanimal variation of radioresistance (in turn dependent on the interanimal variations of five parameters); and randomness in the number of stem cells surviving, and in the effective proliferation per stem cell. Data on mice are analyzed in accordance with this proposed theory. (auth)

43204 (CONF-680517–1) RADIATION EFFECTS ON COBRA VENOM. Lauhatirananda, Prasit; Hayodom, Vichai (Queen Saovabha Memorial Inst., Bangkok (Thailand)). [1967]. 7p. Dep.

From Snake Venom Meeting, Bangkok, Thailand.

From these studies, it was concluded that γ irradiation definitely affects Cobra venom regarding sterilisation, detoxification, and antigenic activities if the venom is irradiated in aqueous form. Effects of γ irradiation in lyophilised form are not verified by these experiments that are limited to doses not exceeding 4 Mrads. In sterilisation of fresh venom, diluted 15 times with water, the decimal reduction dose is estimated to be about 16,000 rads. In principle, due to many varieties of organisms, the decimal reduction dose should depend on the existing fractions of various organisms that may have different radiosensitivities. Antigenic component was destroyed in proportion to the destruction of toxic component. (auth)

43205 (COO–894–30) ENERGY TRANSFER AND UTILIZATION IN THE PHOTOSYNTHETIC PROCESS. Technical Progress Report, May 1, 1967–May 1, 1968. Lumry, Rufus (Minnesota Univ., Minneapolis. Lab. for Biophysical Chemistry). May 25, 1968. Contract AT(11-1)-894. 13p. Dep. CFSTI.

FLUORESCENCE — radiation effects on, of carotenes and carotenoids, effects of solvent and temperature on uv; solvent effects on, of pure solutions of chlorophyll; quenching from excited state complexes of indoles, kinetics of temperature effects on; properties of phycoerythrins, effects of protein structure integrity on chromophore migration in relation to; quenching mechanism of indole; chlorophyll, in alcoholic solution, chemical quenching processes of; indole exciplexes in relation to quenching processes in, kinetics of; excitation spectra for indole, effects of solvent on

CHYMOTRYPSIN—energy state of, kinetic studies of effects of pH on; photooxidation of, amino acid analysis of products from limited
CHLOROPLASTS—intrinsic activity of preparations of, control of rate of oxidant-dependent loss of
PROTEINS—energy migration in, following excitation of indole groups, pathways for (E.R.B.)

43206 (JPRS-45973) PROTECTIVE ACTION OF ORGANO-PHOSPHORUS COMPLEXING AGENTS IN POISONING BY SOLUBLE BERYLLIUM COMPOUNDS. Arkhipova, O. G.; Dvizhkov, P. P.; (and others). Translated from Gig. Sanit., 33: No. 5, 26-31(May 1968). 8p. CFSTI.

The article presents the results of an experimental study of the protective action of several substances in acute beryllium poisoning revealed that aminoalkylpolyphosphinic acids have such action. (auth)

43207 (NYO-2373-3(App.)) MULTIPLE CHROMOPHORE SPECIES IN PHYTOCHROME. Progress Report. Correll, David L.; Edwards, John L.; Shropshire, W. Jr. (Smithsonian Institution, Washington, D. C. Radiation Biology Lab.). [nd]. Contract AT(30-1)-2373. 301p. Dep. CFSTI.

Buffered aqueous solutions of pure phytochrome, when irradiated at 730 nm, had a main absorption band at about 660 nm and a shoulder or secondary band at 580 to 600 nm. When irradiated at 660 nm, these absorption bands bleached and a pair of bands at 670 and 725 to 730 nm appeared. When 660 nm-irradiated samples were placed in the dark the 730 nm absorption slowly bleached and the 670 nm absorption band shifted to 660 nm. The kinetics of the bleaching indicated that two populations of P_{FR} existed initially. These two populations decayed by first order kinetics with k's of 4.8×10^{-4} sec^{-1} and 3.1×10^{-6} sec^{-1} at 25°. While the bleaching of P_{FR} was occurring, the appearance of the 660 nm and 580 to 600 nm absorption bands characteristic of P_R took place. The kinetics of the increase in the 580 and 660 nm absorption bands indicated that it was arising from two populations of reactants by two first order reactions with k's of 6.4×10^{-4} sec^{-1} and 3.1×10^{-6} sec^{-1} at 25°. When the sodium chloride concentration of the solvent was changed the proportions of the kinetically different populations were altered. In some conditions, especially in the presence of air, reversible, but non-reciprocal changes in the four absorption bands were observed. These effects were evident after the lapse of many hours in the dark. When native phytochrome was treated with sodium dodecyl sulfate all absorption bands but the 580 to 600 nm absorption band were bleached and photoreversibility was lost. When native phytochrome was treated with glutaraldehyde, the 730 nm absorption band was bleached out photoreversibility was retained. It was concluded that at least four species of chromophore exist in phytochrome with absorption maxima at 580, 660, 670, and 730 nm. Each chromophore is capable of being bleached by appropriate irradiation or in the dark by chemical reactions rather than photochemical reactions. The reactions are probably coupled redox reactions between the 580 to 660 nm pair and the 670 to 730 pair of chromophores. Discrepancies observed in the reciprocity of the absorption changes in these paired bands are probably due to various degrees of uncoupling and secondarily to the redox potential of the solvent when such uncoupling occurs. (auth)

43208 (UCSF-10-P-2-39) ANNUAL REPORT [ON RADIOBIOLOGY], 1967. (California Univ., San Francisco. Lab. of Radiobiology). Contract AT-11-1-GEN-10. 265p. Dep. CFSTI.

Fifteen papers are presented dealing with radiobiological studies at the molecular, cellular, and organismic levels. The papers are divided into three sections as follows: Molecular and Cellular Level Studies; Radiation Genetics; and Somatic Effects of Radiation. Separate abstracts are included on each of the three sections. (E.R.B.)

For abstracts of individual sections see: 43209, 43276, and 43349.

43209 (UCSF-10-P-2-39, pp 2-51) MOLECULAR AND CELLULAR LEVEL STUDIES. (California Univ., San Francisco. Lab. of Radiobiology).

Four papers are presented in this section discussing the effects of radiation at the molecular and cellular levels. In one study, the effects of x irradiation on DNA synthesis in cultured HeLa cells were determined using the incorporation of tritium-labeled thymidine and ^{14}C-labeled orotic acid for measurement. The effects of prior uv irradiation on x-ray-induced inhibition of DNA synthesis in cultured HeLa cells are also discussed. Results indicate that the uv-induced pyrimidine dimers in DNA molecules overlap very little with the x-ray-induced DNA strand breaks that result in a steep depression of DNA synthesis. The third paper in this section discusses the repair of damaged HeLa cell DNA. Two forms of DNA synthesis (semiconservative and nonconservative) occur in HeLa cells following uv irradiation. The latter type consists of the insertion of small numbers of nucleotides into preexisting DNA molecules and is characteristic of the repair replication processes observed in bacteria. The final paper discusses tritium-suicide in mammalian cells. Experiments designed to determine the effects of β-decay by tritium on labeled mouse lymphoma cells demonstrated a definite local effect due to the decay. The billing efficiency per disintegration is greatest in DNA and decreases in the order of nuclear RNA, whole cell RNA, and whole cell pool plus protein. On the basis of these results, no distinction could be made between the relative importance of β irradiation and transmutation. (E.R.B.)

43210 EFFECTS OF VARIOUS DIETS ON THE DEPOSITION AND UPTAKE OF INJECTED ^{91}Y AND MIXED URANIUM FRAGMENTS. Borisova, N. D. Tr. Inst. Biol., Akad. Nauk SSSR, Ural. Filial, No. 46, 99-109(1966). (In Russian).

Diets adequate for maintenance of mice before and after introduction of yttrium affected their metabolic behavior to the same degree. Diets affecting organic exchange (albuminless, carbohydrate, and fatty diets) produced insignificant changes in the behavior of Y, principally in soft organs; diets affecting mineral exchange altered the yttrium content of soft organs and the femur. A reduction was observed in the content of yttrium in the liver for all diets, whereas in the skeleton there was an increase during a richitic diet, a decrease during a calcium diet, and a lack of change in a carrot diet. The addition of phosphorus to the richitic diet somewhat increased the content of yttrium in the skeleton and liver. Fatty, carbohydrate, and albuminless diets decreased and an albumin diet increased the resorption of yttrium from the gastrointestinal tract. The greatest effect in the elimination of yttrium from the organism was obtained by the introduction of EDTA into the richitic diet; EDTA gave a somewhat greater effect in deficient diets than for regular diets. The introduction of trimethylphosphate and estrogen caused no effect on the behavior of yttrium under all diet conditons. (tr-auth)

43211 EFFECTS OF X-RAYS ON A HUMAN TUMOR GROWING IN ORGANO-TYPIC CULTURE. Dendy, P. P. (College de France, Paris). Eur. J. Cancer, 4: 163-72(May 1968).

The human tumor used in these experiments was maintained by Wolff and Wolff in organo-typic culture for a number of years. When the material was subected to a single dose of x rays, results showed that changes in mitotic index and the production of severe necrosis and tumor death were radiosensitive processes while DNA metabolism and respiration are relatively insensitive. By delivering a second equal dose of x rays five days after the first, it was shown that recovery at the cellular level was already practically complete. Morphological recovery was not visible until at least 15 days after irradiation and at higher doses took the form of regenerating nodules of healthy tissue. A second dose of x rays at 42 days indicated that this new material exhibited the same radiosensitivity as the original. (auth)

43212 ENVIRONMENTAL AND BIOCHEMICAL CONTROL OF STRONTIUM IN SHELLS OF CARDIUM EDULE. Hallam, A. (Oxford Univ.); Price, N. B. Geochim. Cosmochim. Acta, 32: 319-28(Mar. 1968).

Shells of the mollusc Cardium edule, collected from thirteen stations in Europe covering a wide range of temperature and salinity, were analysed for strontium by X-ray fluorescence spectrometry. The inner shell layer was shown to have significantly higher Sr values than the outer layer, whose detailed analysis was the main concern of the study. There was an inverse relationship between Sr content and temperature, but no evident relationship with salinity. The strong within- and between-sample variation did not appear to be controlled by variations in either growth rate or amount of shell secreted. Possible implications for palaeoecology are briefly discussed. (auth) (UK)

43213 DISCRIMINATION BETWEEN HEAVY WATER AND WATER BY THE MOUSE. Zalik, S. (Univ. of Alberta, Edmonton). Nature (London), 218: 1081(June 15, 1968).

Some comments are made on the communication by Smith (Nature 217: 760 (1968)), particularly with regard to the limited data from which conclusions were drawn. (UK)

43214 DELAYED INITIATION OF DNA SYNTHESIS IN IRRADIATED HUMAN DIPLOID CELLS. Little, J. B. (Harvard School of Public Health, Boston). Nature (London), 218: 1064-5 (June 15, 1968).

Most studies of the effects of ionizing radiation on the mitotic cycle in mammalian cells have been made with rapidly multiplying cells, and in vitro systems have included primarily established cell lines or tumor cells. Experiments are described on morphologically pure cultures of human diploid cells, freshly explanted from normal tissue and having a very long generation time in vitro. The initiation of DNA synthesis (as measured by thymidine incorporation) appears to be a highly radiosensitive process in these cells, the entry of cells into the synthetic phase being significantly slowed by exposures as low as 10R and completely blocked by over 300R. Cultures of primary human amnion cells were irradiated using a 250 KVp X-ray generator, and results are shown for control and irradiated cultures continuously incubated up to 7 days with ^{14}C-thymidine. There was a steady increase in the percentage of labeled cells in the control cultures, this being evidence of a continuous flow of cells into the DNA synthetic phase. On the other hand, there was no increase after the first day in 1000R irradiated cultures, indicating blocking in the passage of cells into the synthetic phase. This finding was confirmed using ^{3}H-thymidine. The findings of other workers are described. The present results suggest that normal cells with a long generation time may respond differently to irradiation compared with rapidly dividing cells of the same species. A similarity in response of the amnion cells to regenerating liver cells is interesting. The differing response of these cells might also be of significance in the radiation therapy of malignant tumors. (UK)

43215 CALCIUM DISTRIBUTION IN LEAVES: AUTORADIOGRAPHY VERSUS CHEMICAL ANALYSIS. Thomas, W. A. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Int. J. Appl. Radiat. Isotop., 19: 544-5(June 1968). (ORNL-P-3368).

Although techniques for preparing autoradiograms of plants have been developed, little attention has been given to the distribution of the stable element in material used for autoradiography. Published autoradiograms of leaves containing ^{45}Ca have led to the general conclusion that calcium is concentrated in the petiole and larger veins. Autoradiograms of leaves collected in July from flowering dogwood (Cornus florida L.) trees which had been stem-inoculated with ^{45}Ca in early May also showed apparent accumulation of radiocalcium in the petiole, midrib, and primary lateral veins. Two experiments are described to determine if autoradiograms truly represented the distribution of stable calcium in these leaves. It was concluded that although autoradiograms are useful in many phases of plant nutrition research, this technique alone may not indicate where the stable element is concentrated on a total leaf basis. (UK)

43216 INTESTINAL TRANSPORT AND METABOLISM FOLLOWING WHOLE-BODY IRRADIATION. Perris, A. D. (National Research Council of Canada, Ottawa). Radiat. Res., 34: 523-31 (1968).

In the male rat three days after 650 R of whole-body irradiation, intestinal transfer of glucose, galactose, and 3-o-methyl glucose in vivo was reduced, whereas sorbose transfer was increased. Only when low levels of glucose were also present was in vitro galactose transfer inhibited by radiation. Radiation depressed lactic acid production in the intestine but did not alter citric acid accumulation following fluoroacetate administration. The radiation-induced decrease in the glycolytic energy supply could account for the transport defects observed. (auth)

43217 RELATIONSHIP OF GERMINAL CENTERS IN LYMPHOID TISSUE TO IMMUNOLOGICAL MEMORY. II. THE DETECTION OF PRIMED CELLS AND THEIR PROLIFERATION UPON CELL TRANSFER TO LETHALLY IRRADIATED SYNGENEIC MICE. Wakefield, J. D.; Thorbecke, G. J. (New York Univ.). J. Exp. Med., 128: 171-87(July 1, 1968).

White-pulp cells and whole spleen from donor mice immunized with sheep erythrocytes were transferred intravenously to heavily x-irradiated mice. The numbers of plaque-forming cells and the amount of hemagglutinating antibody produced after reexposure to antigen were measured. When reexposure to sheep erythrocytes was delayed, a much greater response occurred in the transferred cells. Peak responsiveness was reached at 24 hr after transfer. This lag effect was greatly reduced by repeated injections of 5-bromodeoxyuridine into the recipient mice prior to challenge with antigen. It was therefore concluded that much of the increase in responsiveness was due to a proliferation of primed cells after cell transfer. The fact that a significant response was given by the transferred cells in spite of 5-bromodeoxyuridine treatment suggested that some of the primed cells were nondividing. White pulp was a much richer source of responsive cells than was whole spleen. (auth)

43218 THE INACTIVATION OF ALCOHOL DEHYDROGENASE BY X RAYS AND DOSE-MODIFYING EFFECT OF SOME ADDED SUBSTANCES. Gorin, George; Quintiliani, Marcello; Airee, Shakti K. (Oklahoma State Univ., Stillwater). Radiat. Res., 32: 671-84(1967).

The inactivation yield of yeast alcohol dehydrogenase in 0.05 M phosphate buffer, pH 7, induced by x radiation, was found to be 0.14 molecule per 100 eV. The apparent yield was constant in the range 0.1 to 1 mg/ml, showing that adventitious impurities had no appreciable effect. The yield was little affected by changing the pH to 6 or 8, or by omitting the buffer. Possible reasons for discrepancies in earlier measurements are discussed. It was concluded that, on the average, many reactions with radiation-produced intermediates are necessary to inactivate one enzyme molecule. In fifty-fold molar excess, cysteine, cysteamine, and cystine exerted a limited protective action (dose-reduction factor 2 or less); sodium iodide and 3-iodopropionic acid had a substantial sensitizing effect, cystamine a slight effect, and methanesulfonate ion and ethyl methanesulfonate negligible effects. (auth)

43219 ON THE INFLUENCE OF RADIOINDUCED ELECTROLYTE CHANGES ON METABOLISM. I. STUDY OF COACETOKINASE IN YEAST. Rink, Hermann; Bergeder, Hans-Dietrich). (Univ., Bonn). Strahlentherapie, 135: 354-63(1968). (In German).

The influence of K$^+$ and Na$^+$ concentrations of unirradiated and irradiated yeast on the enzyme coacetokinase and its substrate acetate was investigated. Also, the influence of K$^+$- and Na$^+$-ions on the enzyme activity was investigated in vitro. In vivo irradiation with 200 kR caused a considerable decrease in K$^+$-content and an increase in Na$^+$-content of yeast. The activity of coacetokinase, isolated from yeast irradiated with the same dose, was unchanged; the substrate level (acetate concentration), however, increased in the irradiated yeast. This was shown by a further result, that the activity of the enzyme coacetokinase was inhibited by an increase in Na$^+$-concentration and by a decrease in K$^+$-concentration. K$^+$- and Na$^+$-concentrations required for optimum enzyme activity depended in vitro upon the protein content of the solution used. From the results, it was concluded that radioinduced electrolyte displacements could influence the metabolism of the cell via K$^+$-Na$^+$-depending enzymes. (auth)

43220 PROBLEMS AND METHODS IN FOOD ANALYSIS. Bergner, K. G. (Lehrstuhl Lebensmittelchem., Stuttgart). Deut. Apoth.-Ztg., 107: 215-20(1967).

Problems encountered in the analysis of foodstuffs are briefly discussed, with particular reference to confectionery, egg products, wine, the enzymic differentiation between fresh and frozen meat, the addition of dyes and preservatives, and the effect of radioactive constituents on animal and vegetable foods. (17 references). (auth)

43221 CONTINUOUS ^{14}C GLUCOSE TRACER MODELS FROM DISCRETE EXPERIMENTAL DATA. Schoenemann, P. T.; Smith, O. J. M.; Manougian, E. (Univ. of California, Berkeley). pp 233 of Proceedings of the 19th Annual Conference on Engineering in Medicine and Biology, San Francisco, California, November 14-17, 1966. Volume 8. Vurek, Gerald G. (ed.). New York, Institute of Electrical and Electronics Engineers and Pittsburgh, Instrument Society of America, 1966. See CONF-661119.

43222 EFFECT OF SOME CHELATING AGENTS ON RADIOSTRONTIUM METABOLISM. Kostial, K.; Vojvodic, S.; Maljkovic, T. (Inst. of Medical Research and Industrial Hygiene, Zagreb). Arh. Hig. Rada Toksikol., 18: 111-23(1967). (In Slovak).

The effects of the chelating agents, cyclopentanediaminetetraacetic acid (CPDTA), dimethylethylenediaminetetraacetic acid (DIMEDTA), and propylenediaminetetraacetic acid (PDTA), on retention of ^{85}Sr in the skeleton of rats were studied. An intraperitoneal injection of ^{85}Sr was immediately followed by an intraperitoneal injection of the chelating agent in a dose of 0.8 millimole/kg in the form of the di-Na salt of the Sr chelate. To determine the relative effect on Sr compared with Ca, ^{47}Ca was also injected into the animals. Only CPDTA, which had the highest stability constants for the Ca and Sr derivatives and the lowest ratio of the stability constant of the Ca to that of the Sr derivative, was effective. (JPRS)

43223 ULTRAVIOLET EFFECTS ON POLYNUCLEOTIDES. Pearson, Mark; Johns, H. E. (Ontario Cancer Inst., Toronto). pp 353-69 of Canadian Cancer Conference. Vol. 7. Morgan, J. F. (ed.). New York, Pergamon Press, 1967.

From 7th Canadian Cancer Research Conference, Honey Harbour, Ontario, Canada, June 1966. See CONF-660658.

Ultraviolet irradiation of nucleic acid components resulted in the formation of dimer and hydrate photoproducts among the pyrimidine bases. Measurement of the number of these photoproducts as a function of exposure in uridylyl-(3′-5′)uridine (UpU), polyuridylic acid (poly U), and poly (A + U) allowed us to determine the effects of chain length and secondary structure on the formation of these photoproducts. It was found that increasing the chain length from that in UpU to that in poly U resulted in a non-random distribution of photoproducts within the chain so that dimers tended to appear in clusters, although the total yield of dimers and hydrates was the same in poly U and UpU. On the other hand, in the double-stranded complex poly (A + U), the rates of dimer and hydrate formation were reduced by factors of five and 10 respectively compared to poly U alone. Experiments designed to elucidate the coding properties of dimers and hydrates in mRNA suggested that these photoproducts may miscode and result in the formation of altered proteins. (auth)

43224 AGE AND SEX DISTRIBUTIONS FOR SOME IDIOPATHIC NON-MALIGNANT CONDITIONS IN MAN. SOME POSSIBLE IMPLICATIONS FOR GROWTH-CONTROL AND NATURAL AND RADIATION-INDUCED AGEING. Burch, P. R. J. (Univ. of Leeds, Eng.). pp 117-55 of Radiation and Ageing. Lindop, Patricia J. (ed.). London, Taylor and Francis Ltd., 1966.

From International Colloquium on Radiations and Ageing, Semmering, Austria, June 23-24, 1966. See CONF-660635.

Examples are presented of the sex and age distributions of various idiopathic non-malignant diseases and aging conditions in man. These distributions are consistent with the generalizations that each disease is confined to a given genotype, is initiated in predisposed individuals through the occurrence of random events (somatic gene changes), and has a latent period between initiation and clinical onset. It is suggested that these diseases result from an attack by autoantibodies on specific target cells. A hypothesis is presented that provides a theoretical basis for these observations. The effects of radiation on autoimmune diseases and aging are discussed with reference to the proposal that predisposing alleles direct the synthesis of specific products, both in particular cells of the lymphoid system and in target cells. This proposal is used to explain normal growth control, autoimmune diseases, and aging. (M.M.B.)

43225 CONSIDERATION OF THE ROLE OF AUTOIMMUNITY IN AGEING AND IN THE LATE EFFECTS OF IRRADIATION. Guttman, Paul H. (Univ. of California, San Francisco). pp 77-81 of Radiation and Ageing. Lindop, Patricia J. (ed.). London, Taylor and Francis Ltd., 1966.

From International Colloquium on Radiations and Ageing, Semmering, Austria, June 23-24, 1966. See CONF-660635.

Intercapillary glomerulosclerosis is a progressive renal lesion in aging rodents that may be accelerated by x irradiation. The severity of the lesion and the rate of acceleration is dependent on the radiation dose and the age of the animal when irradiated. Neonatal thymectomy potentiates the radiation effects on the kidneys. Splenectomy performed several weeks after thymectomy reduces the extent and degree of radiation response in animals irradiated at birth. The evidence suggests an autoimmune response that could be due to any of three mechanisms: release of cellular antigens into the circulation after radiation injury, radioinduced somatic mutations resulting in the formation of antigens that induce an antibody response, or virus invasion causing an autoimmune response. (M.M.B.)

43226 BEHAVIOUR OF LEUCINAMINOPEPTIDASE AND γ-GLUTAMYLTRANSPEPTIDASE IN THE LIVER AND SPLEEN OF PANIRRADIATED RATS. Tittobello, A.; Zanolla, W. R.; Stabilini, R.; Vergani, C.; Casolo, F. (Univ., Milan. Univ., Pavia, Italy). Minerva Radiol., Fisioter. Radiobiol., 12: 189-92(May 1967). (In Italian).

The data relative to the behavior of leucinaminopeptidase (LAP) and γ-glutamyltranspeptidase (γ-GT) in the liver and spleen of rats after total irradiation with Roentgen rays in a single dose of 800 r are reported. The alterations in the quantities of the two enzymes and the variations in the electrophoretic picture of LAP observed over a period from five to ten days, would seem to confirm two hypotheses; the existence of a process of distribution or of inactivation of a high level of enzymes in the tissues, limited to the first three to four days, and of a process of cellular regeneration in the immediately subsequent period. (auth)

43227 AMYLASE ACTIVITY DURING GERMINATION OF γ-IRRADIATED CASTOR SEEDS. Thanki, R. J.; Patel, K. C.; Patel, R. D. (Sardar Patel Univ., India). Z. Naturforsch., 23b: 946-9(July 1968).

Amylase activity was not detected in the resting seeds. The amylase activity is newly formed during germination of the control and the irradiated seeds. The activity is greatly affected by γ-irradiation. The high proportion of amylase in the control seedlings may be the result of the more active metabolic state of the seedlings. Irradiation is reported to interfere with the function of mitochondria. Ascorbic acid inhibits the activity. Free amino acid cystine also plays a role in the liberation of the amylase activity. Starch is utilized as one of the metabolites during germination. (auth)

43228 INVESTIGATION OF THE AGGREGATION MECHANISM OF γ-IRRADIATED LYSOZYME BY THE TURBIDIMETRIC METHOD. Maksimov, V. I. (Zelinskii Inst. of Organic Chemistry, Moscow). Biochemistry (USSR) (Engl. Transl.), 32: 694-9 (July-Aug. 1967).

Aggregation of γ-irradiated lysozyme (dry preparation) followed an induction period under definite conditions; the ionic strength, pH, and protein concentration had threshold values for the aggregation rate. The pH function indicated retention of elements of the native-protein structure in irradiated lysozyme. Small amounts of dodecylsulfate caused a very large acceleration of aggregation. Comparatively small urea concentrations caused severe inhibition of aggregation. The possibility of an aggregation mechanism involving simultaneous denaturation and proceeding like a chain process is discussed. This mechanism was used to explain the kinetic regularities observed in the aggregation of irradiated lysozyme. (auth)

43229 ENZYMATIC DEGRADATION OF DESOXYRIBONUCLEOPROTEIN, ISOLATED FROM TISSUES OF THE NORMAL ANIMAL AND AFTER GAMMA-IRRADIATION. Ermolaeva, N. V. (Inst. of Biophysics, Moscow). Biochemistry (USSR) (Engl. Transl.), 32: 639-43(July-Aug. 1967).

Translated from Biokhimiya, 32: 774-8(July-Aug. 1967).

During incubation of low-purity deoxyribonucleoprotein (DNP) preparations from rabbit thymus, appendix, and liver, there was a degradation resulting in conversion of the DNP to a salt-soluble form, and this conversion took place optimally at pH 6.0 to 6.5. Incubation of purified DNP preparations from the same organs with an enzyme fraction from calf thymus and different from DNAases and proteinases, also produced the degradation at pH 6.0. The action of this fraction showed species specificity. In the presence of the enzyme fraction, the rate of degradation of the thymus and appendix DNP, isolated 10 min, one, two, and six hr after irradiating rabbits with γ rays at a dose of 800 R, showed a progressive decrease but the DNP preparations from liver did not show any significant changes in this respect. (auth)

43230 USE OF LOW-MOLECULAR FRAGMENTS OF CHITIN FOR CHARACTERIZING THE ACTIVITY OF γ-IRRADIATED LYSOZYME. Maksimov, V. I.; Osipov, V. I.; Kaverzneva, E. D. (Zelinskii Inst. of Organic Chemistry, Moscow). Biochemistry (USSR) Engl. Transl.), 32: 964-8(Nov.-Dec. 1967).

Translated from Biokhimiya, 32: 1169-74(Nov.-Dec. 1967).

The activities of γ irradiated lysozyme and fractions I and II obtained from it against Micrococcus lysodeikticus and low-molecular fragments of chitin were ascertained. The relative activities using the two types of substrate were practically the same. The preliminary results indicate that the activity of irradiated lysozyme towards oligosaccharides does not differ in character from that of native lysozyme. (auth)

43231 EFFECTS OF THE SEX, AGE, CASTRATION, SEX HORMONES, AND ADRENALECTOMY ON ^{137}Cs AND ^{144}Ce DISTRIBUTION AND UPTAKE IN RATS. Kulikova, V. G. Tr. Inst. Biol., Akad. Nauk SSSR, Ural. Filial, No. 46, 111-23(1966). (In Russian).

In the first period after introduction in muscles, liver, and skeleton of females, the deposition of cesium was higher in females than in males. Cesium was deposited more in the skeleton of young animals. In young males and females cesium was deposited to the same degree; in old animals it was greater in males. Castration eliminated the distinction in the distribution of cesium; its lower content in the skeleton of females was approximately the level of concentration in non-castrated females. Castration reduced the concentration of cesium in aged males and females in the skeleton, but in young animals the effect of castration was not evident. The effect of estrogens on the distribution of cesium depended on the sex and castration. Multiple introduction of estrogens (especially in large doses) significantly reduced the content of cerium in the skeleton of mice and was not dependent on castration and sex. Multiple introduction of progesterone delayed the elimination of cesium from muscles and skeleton of castrated males in comparison with non-castrated males. Progesterone did not affect cerium. Adrenalectomy increased the content of cerium in muscles, lungs, skeleton, and liver of females. (tr-auth)

43232 DYNAMICS OF RADIOSTRONTIUM ACCUMULATION BY SOME BROWN ALGAE AND THE INFLUENCE OF SEA WATER SALINITY ON THE COEFFICIENTS OF ACCUMULATION. Zlobin, V. S. Okeanologiya, 8: 78-85(1968). (In Russian).

Processes of ^{90}Sr accumulation and release by the brown algae Ascophyllum nodosum, Fucus serratus, and Fucus vesiculosus were studied. Experiments on radiostrontium accumulation were made in aquaria. Desorption was attained by placing radioactive algae in nets in the water of a bay. Release of ^{90}Sr from the algae could be adequately described by the equation: $q_{(t)} = 11.2 (0.112e^{-0.693t/37} + 1.2e^{-0.693t/0.75}) \cdot 10^{-8}$ Ci/Kg. The equiponderant coefficients of radiostrontium accumulation (CA) were equal to: 46 ± 2 at potassium concentrations of 0.37 g/l, 39 ± 4 at 0.737 g/l, and 43 ± 5 at 1.094 g/l. Differences between the series were not statistically significant. The relation between ^{89}Sr accumulation coefficients (A) in algae and the concentration (C) of stable Sr in seawater (which, in turn, was assumed to be linearly dependent upon salinity) had the form: $A_{(C_{Sr})} = 331\,(0.14e^{-0.693c/52} + 0.88e^{-0.693c/1.62})$. A 2-component character of the dependence of CA upon C is determined by 2 interrelated processes, namely by radiostrontium adsorption at the surface of the alga and by the exchange of surface ions with the ions in cellular structures. (BBB)

43233 CONTAMINATION OF SOILS AND PLANTS BY ARTIFICIAL RADIOACTIVITY. Benes, Jaroslav (Lab. for Radiometric Dosimetry, Prague). Jad. Energ., 14: 182-8(May 1968). (In Czech).

Sorption of artificial radioactive substances by soil, sorption and desorption of radioactive waste, and factors influencing these processes are discussed. The uptake of radioactive elements from soil by plants, especially the uptake of radioisotopes by the roots of plants in the course of food supply, is evaluated. (tr-auth)

43234 SOME ASPECTS OF THE BIOCHEMISTRY OF PLASMA IN THE IRRADIATED RABBIT. **Mehran, A. R.; Loiselle, J. M.; Blais, R. (Univ. Laval, Quebec). Arch. Int. Physiol. Biochim., 75: 429-40(1967). (In French).**

Experiments were undertaken to study the metabolic interrelations and to evaluate radioinduced changes in plasma. Rabbits received a single dose of 1600 R of γ radiation from ^{137}Cs. Effects on proteins, lipids, and cortisol levels in the plasma were observed simultaneously for two days following irradiation. The amount of albumin and γ-globulin fractions decreased and the total proteins stayed the same, but all other constituents studied increased with development of the acute radiation syndrome. Corticoids increased regularly after irradiation to at least six times that of control plasma. Mobilization of fats from adipose tissue was considerable, as shown by increased nonesterified fatty acids. β-Lipoproteins increased in the plasma. It was concluded that the liver released into blood the lipid fragments it received from the adipose tissue. This secondary response of the liver to irradiation was borne out by the progressive increase in total lipids, neutral fats, and cholesterol, observed throughout the radiation syndrome. This capacity of the liver for synthesis held for proteins as well as lipids, since almost all the plasma globulins increased during the acute radiation syndrome. The decrease in γ-globulins was attributed to the extreme radiosensitivity of cells synthesizing them. (BBB)

43235 POTASSIUM AND ^{137}Cs DISTRIBUTIONS IN ANGUS STEER CARCASSES. Duggleby, J. C. (Commonwealth X-ray and Radium Lab., Melbourne); Seebeck, R. M. J. Agr. Sci., 69: 149-53(Oct. 1967).

By use of a multichannel pulse-height analyzer and NaI crystal detector, K and ^{137}Cs levels were determined at the same time, and calculations made of the Cs/K ratios in the different parts of the carcasses to examine their relation to the average daily ^{137}Cs intake in the food of the animals. The feasibility of using particular muscles from grazing cattle to monitor the ^{137}Cs deposition from fallout on their pastures was also evaluated. Seven Angus steers were reared under controlled conditions, slaughtered and their carcasses dissected. Muscles, fat, bones, connective tissues, and samples of the steers' diet were measured by spectrometry. Significant variations in the concentration of both elements were found both within and between tissues. Average K concentration was about four times greater in the muscle tissue than in the remainder of the carcass. The Cs/K ratios were similar in both muscle and fat but no ^{137}Cs was detected in bone. It was concluded that the variations of K concentrations in muscle could impose limitations on the ^{40}K technique for estimating muscle content of the living animal for scientific purposes, though not necessarily for estimating commercial value. Differences between animals in ^{137}Cs content of muscle were fairly consistent over the different muscle groups, and bore some relation to Cs intake. Thus it might be possible to utilize Cs content of a representative muscle to monitor ^{137}Cs fallout in remote regions of Australia, where milk was not produced. (BBB)

43236 ^{59}Fe ABSORPTION BY CHICKENS. **Edwards, Hardy M. Jr.; Washburn, Kenneth W. (Univ. of Georgia, Athens). Poultry Sci., 47: 337-8(Jan. 1968).**

Eight, day-old New Hampshire female chickens were fed a skim-milk diet supplemented with 100 ppM of Fe and 10 ppM Cu for two weeks. They were then fed this same diet for nine weeks, or the skim milk diet supplemented with 2 ppM of Cu and 20 ppM of Fe. Some chickens then received 0.02 μCi of ^{59}Fe (0.8 μCi/ml) intramuscularly or 0.05 μCi of the same ^{59}Fe solution orally. The birds fed the diet deficient in Fe and Cu, beginning at two-weeks of age, developed detectable anemia by six weeks of age. At 11 weeks of age the average packed erythrocyte volumes of the groups used for the ^{59}Fe absorption study were 30.2% for the group receiving adequate Fe and Cu and 27.4% for the group receiving the inadequate Fe–Cu diets. The average packed erythrocyte volumes of the groups selected at random at 11 weeks were 31.3% for the adequate Fe–Cu group and 25.9% for the group receiving the low Fe–Cu diet. The chickens which had been fed the diet containing a low level of Fe and Cu absorbed ~ four times more of the oral ^{59}Fe dose than the birds fed the higher level of Fe and Cu. (BBB)

43237 RADIOSENSITIVITY OF NATURAL HYBRID DNA–RNA IN EMBRYOES OF PEAS. Tokarskaya, V. I. (Inst. of Biological Physics, Moscow). Dokl. Akad. Nauk SSSR, 180: 482-5(May 11, 1968). (In Russian).

The properties and radiosensitivity of natural hybrid DNA-RNA were studied in dry pea seeds irradiated with ^{137}C γ-rays to a dose of 20 kR at a dose rate of 700 R/min. The seeds were soaked for 16 hr and the embryo separated and incubated for 3 hr in tris buffer pH 7.4 ± 0.01, MEDTA, and radioactive sodium phosphate (^{32}P) with an initial activity of 100 μCi/ml and in ^{14}C-uridine with an initial activity of 20 μCi/ml. The results of chromatographic analysis of the natural complex and irradiated complex are presented in graphical form. It was found that irradiation of the seeds resulted in the disturbance of active sections of the matrix in which the synthesis of information RNA took place, followed by a reduced number of synthesized hybrid complexes of DNA-RNA. Irradiation also induced some non-specific activation (de-repression) of the new areas of DNA matrix with a new ribosomal RNA type of synthesis. The results, revealing an increased RNA cell mass and reduced synthesis of information RNA after irradiation, confirmed and explained published data on the radioinduced increase of RNA cell mass. (R.V.J.)

43238 REGULARITY OF CARBON ISOTOPE (^{14}C) MIGRATION AND METABOLISM. Zapol'skaya, N. A.; Fedorova, A. V.; Pavlitskaya, E. D. (Leningrad Scientific-Research Inst. of Radiation Protection). Gig. Sanit., No. 5, 49-53(May 1968). (In Russian).

The dynamics of the passage of ^{14}C into the milk of dairy cattle were studied. Observations were carried out on two cows and two goats that were fed with food ration containing glucose labeled with ^{14}C for a period of six days. The finding was that 26% of the activity introduced with the food proved to be in the milk: 13% of the activity was in the cream, and 13% in the milk serum. After ceasing the ^{14}C introduction, the milk was soon decontaminated. Twenty per cent of the activity introduced was retained by the adipose tissue, and the same amount was retained in the muscles. On the basis of the results obtained, an approximate calculation was made of the permissible amount of ^{14}C of animal origin in the human diet. (auth)

43239 MECHANISM OF THE BACTERICIDAL ACTION OF γ-RADIATION. Cherkinskii, S. N.; Ryabchenko, V. A. (Moscow Inst. of Medicine). Gig. Sanit., No. 5, 10-14(May 1968). (In Russian).

The mechanism of γ-radioinduced inactivation of bacterial dehydrogenase was investigated in Salmonella typhi. The relation of the bactericidal effect of γ rays to their action on the activity of dehydrogenase was studied, and the action of γ radiation on dehydrogenase activity in bacteria was compared to that of uv. (auth)

43240 STRONTIUM AND BARIUM IONS AND GUINEA PIG URETER. **Washizu, Yoshiaki (Univ. of Mississippi, Jackson). Comp. Biochem. Physiol., 25: 367-71(Apr. 1968).**

In guinea pig ureteral smooth muscle, Sr^{2+} substitution for Ca^{2+} increased the duration and the number of spikes of the action potential and duration of phasic contraction. The magnitude of tension development was decreased in phasic contraction as well as in K-induced tonic contraction. The Sr^{2+} activity could be inhibited by Mn^{2+}. Substitution of Ba^{2+} for Ca^{2+} was incapable of maintaining ureteral excitability, although contractile activity was preserved. It was concluded that the physiologic potency of Sr^{2+} was qualitatively and quantitatively different from that of the Ca^{2+} in guinea pig ureter. (BBB)

43241 EFFECT ON METASTASIS OF REMOVING OR IRRADIATING REGIONAL NODES OF MICE. **Crile, George Jr. (Cleveland Clinic Foundation). Surg. Gynecol. Obstet., 126: 1270-2(June 1968).**

When the allogeneic tumor S 180 was minced and implanted on the left hind feet of Swiss mice, removal of the regional (popliteal) nodes along with the primary tumors eliminated most of the immunity of the host to subsequent implants of 500,000 tumor cells on the contralateral feet. Irradiation of the regional nodes was almost as effective as extirpation in reducing the systemic immunity to reimplantation of S 180 tumor cells. Irradiation of the popliteal nodes by 1000 to 1500 R, after it has been immunized by from 5 to seven days of exposure to S 180 implanted on the foot, resulted in an increase in both the incidence and extent of pulmonary metastases. The tumor-bearing feet and the bodies of the mice were shielded with lead while the nodes were being irradiated. Although the increase in the amount of metastasis was not so great after irradiation of the regional nodes as it was after their removal, it was nonetheless considerably increased, 11/80 of the mice with irradiated nodes showing pulmonary metastases as compared with 4/73 control mice with irradiated contralateral nodes. Results indicate that in mice a phase exists early in the growth of an implanted cancer in which lymphocytes in regional nodes become immunized against the cancer, and systemic immunity resides largely in the regional nodes. At this time, either removal or radiation of the nodes increases metastasis. Later, immunity is systemic and not affected by removal or irradiation of regional nodes. (BBB)

43242 THE QUANTITY OF ^{90}Sr IN THE BONE OF LEUKEMIC PATIENTS. **Sato, Chikako (Tohoku Univ., Sendai); Sakka, Masatoshi; Hashizume, Tadashi. Tohoku J. Exp. Med., 94: 45-53(Jan. 1968).**

The possibility that excessive amounts of ^{90}Sr deposited in bone might be related to leukemogenesis was investigated by assays of Sr and measurements of radioactivity of ^{90}Sr in bones obtained from 43 leukemic patients at autopsy performed from 1962 to 1965. The quantity of ^{90}Sr in the bones of leukemic patients averaged 3.17 ± 2.69 μμCi Sr/g Ca in cases under 19 yr of age and 0.47 ± 0.31 μμCi Sr/g Ca in those over 20 yr of age. These values were not significantly different from those of normal Japanese. The bone marrow dose from intraosseous ^{90}Sr was estimated at 2.22 and 0.33 mrad/yr for each age group, respectively. These levels were much lower than the estimated marrow dose of 52.8 mrad/yr for medical uses of radiation in the population. Thus, there was no evidence for leukemogenesis from the ^{90}Sr deposits in bone. (BBB)

43243 STUDIES ON BLOOD FLOW DISTRIBUTION AND COUNTERCURRENT EXCHANGE IN THE SMALL INTESTINE. **Lundgren, Ove (Univ. of Gothenburg, Sweden). Acta Physiol. Scand., Suppl. 303, 42p(1967).**

The washout of intra-arterially injected ^{85}Kr from denervated small intestinal segments (mainly jejunum) of the cat was recorded by a scintillation detector at various degrees of vascular tone induced by graded infusions of isopropylnoradrenaline. Total intestinal blood flow was simultaneously recorded by means of direct, continuous measurements of ^{85}Sr in the venous effluent. At all levels of total intestinal blood flow the ^{85}Sr elimination curve could be resolved into four components by successive subtractions of exponentials. Localization of the tissue compartments corresponding to the four components of the intestinal radioactivity curve was established by the following four independent methods: elimination of the ^{85}Kr activity as registered by two G-M tubes, one located outside the intestine at the antimesenteric border and one in the intestinal lumen, local injections of minute amounts of a ^{85}Kr solution into different parts of the intestinal preparation and the recording of the elimination of the tracer by a G-M tube, washout of antipyrine-^{14}C as investigated by autoradiography, and the comparison of the calculated relative weights of the two slowest compartments of the activity curve with the measured relative weights of the muscularis and the mesentery. Significance of the different portions of the curve was discussed. (BBB)

43244 THE EFFECTS OF IONIZING RADIATIONS ON ENDOCRINE CELLS. VI. ALTERATIONS IN ANDROGEN BIOSYNTHESIS BY CANINE TESTICULAR TISSUE AFTER THE INTERNAL DEPOSITION OF SOME RADIONUCLIDES. Ellis, Legrande C.; Berliner, David L. (Utah State Univ., Logan. Univ. of Utah, Salt Lake City). Radiat. Res., 32: 520-37(1967). (TID-23696).

Male beagle dogs were injected intravenously with various radionuclides (^{226}Ra, ^{239}Pu, ^{228}Th, ^{228}Ra, and ^{90}Sr) when approximately 18 months of age. At various time intervals the testes were removed from the animals and incubated with pregnenolone-7α-^{3}H and progesterone-4-^{14}C. The resulting steroid intermediates were isolated by paper chromatography and derivative formation. The pathways observed for the synthesis of androgens were essentially the same as those observed from perfusion studies by other workers. The 17-α-hydroxylation of progesterone was diminished in all but one animal, which had received ^{90}Sr. Similarly, less androstenedione, testosterone, and total androgens were produced by the tissues from the treated animals as compared to the control group. Pregnanedione was isolated from the incubations of at least eight dogs. The occurrence of this compound with respect to fevers in treated animals was discussed. When a NADPH-generating system was added to incubation of tissues from both groups of animals, there was an increase in steroid biotransformations for both groups. Although the increase in millimicromoles of testosterone and androstenedione production was greater for the control group after the addition of the cofactor-generating system, the percentage of increase in androstenedione, testosterone, and total androgen production was greater for the treated group. (auth)

43245 INVESTIGATIONS ON THE REHABILITATION OF FEED-BACK MECHANISMS IN RADIO-IODINE TREATED HYPERTHYROID PATIENTS. **Dascalu, R.; Rosan, L.; Gozariu, L.; Visinescu, I.; Holan, T.; Pogingeanu, P. Stud. Cercet. Endocrinol., 18: 185-90(1967). (In Rumanian).**

In 40 clinically ascertained radioiodine-treated hyperthyroid patients the extent to which the feed-back mechanisms were rehabilitated was checked 4 to 32 months subsequent to treatment. Two tests resorted to were as follows: the Werner test and another test emphasizing the inhibition of radioiodine release from the thyroid. The disturbance of feed-back mechanisms was evidenced in 36 patients being manifest particularly in longtime Basedow subjects, as against the individuals who were affected by nonexophthalmic forms of hyperthyroidism. The inhibition of radioiodine release might be affected by the time interval. (auth) (Romanian Sci Abstr)

43246 CORRELATION BETWEEN ^{131}I THYROID UPTAKE AND THE ELECTRO-ENCEPHALOGRAM IN POLIOMYELITIS SEQUELAE. **Iurasog, G.; Mihaila, M.; Holan, T.; Farcasanu, M.; Divin, M.; Iacob, T.; Argintaru, D. Stud. Cercet. Endocrinol., 18: 169-78(1967). (In Rumanian).**

Investigations on the modifications of ^{131}I thyroid uptake and electroencephalogram changes were performed in 100 patients with poliomyelitis sequelae. The results revealed 48 normal ^{131}I uptake curves, 24 with an excess of ^{131}I uptake, 8 with a low ^{131}I uptake ability and 20 atypical curves; the electroencephalogram presented 47 normal tracks, 45 committal tracks and 8 interhemispheric asymmetric tracks. The most obvious correlation was ascertained by the study of 28 neurosomatic residual syndromes of a diencephalic type. In these cases, the rate of electroencephalographic and ^{131}I uptake pathological modifications was of 66, and of 75 percent, respectively. The figures included in the paper bring new evidence on the diencephalic-thyroid correlations in this disease, as the hypothalamic lesions of the acute phase, as emphasized by many researchers both in humans and animals. (auth) (Romanian Sci Abstr)

43247 VACUUM ULTRAVIOLET STUDIES ON THE NATURE OF THE RADIATION INACTIVATION OF TRYPSIN. **Yeargers, Edward (Georgia Inst. of Tech., Atlanta); Augenstein, Leroy. Biophys. J., 8: 500-9(Apr. 1968).**

Trypsin, in powder form and in frozen D_2O-glucose solutions, at temperatures from 100° to 300°K, was excited with vacuum uv and near uv radiation to determine how absorbed photon energy was partitioned into radiative, nonradiative, and/or inactivating processes. At 300°K most of the absorbed energy was not reemitted, so that it (0.98 to 0.99 for excitation at 120 nm and 0.75 to 0.90 at 280 nm) was potentially available for inactivation. Since the effects of excitation wavelength and temperature on the emission quenching yields were generally different from those on the inactivation yields of dry trypsin, the mere retention of quenched energy by an enzyme did not necessarily lead to its inactivation. Thus, as predicted previously, the radiation inactivation of trypsin must proceed by specific mechanisms which depend upon environment-sensitive processes, since the nature of the molecular environment could modify the partitioning of energy so significantly. For example, there were differences in the phosphorescence-to-fluorescence ratio, in the activation energy for quenching, and in the lifetimes and kinetics of the decay of phosphorescence when trypsin in frozen glasses and dry trypsin were excited by various wavelengths of uv radiation. (BBB)

43248 SEASONAL CHANGES IN RADIOIODINE UPTAKE AND EPITHELIAL CELL HEIGHT OF THE THYROID GLAND IN THE FRESHWATER TELEOSTS ESOMUS DANRICUS (HAM.) AND MYSTUS VITTATUS (BLOCH) UNDER VARYING CONDITIONS OF ILLUMINATION. **Singh, T. P. (Univ. of Udaipur, Rajasthan, India). Z. Zellforsch. Mikroskop. Anat., 87: 422-8(Apr. 4, 1968).**

At monthly intervals thyroid uptake of ^{131}I and thyroid histology were studied in two fish species, 720 adults being used. Radioactivity of the pharyngeal region was determined 24 and 48 hr after injection of 5 μCi of ^{131}I. The thyroid gland of both *M. vittatus* and *E. danricus* showed seasonal changes in its epithelial cell height and radioiodine uptake. These two indices of thyroid activity agreed in *E. danricus*. Under normal photoperiods both species exhibited two phases of maximum activity, one in April through May, the other in September. The active periods were characterized by high radioiodine uptake and increased follicular cell height. These peaks of activity alternated with quiescent phases, with minimal radioiodine uptake and low follicular epithelium. In specimens exposed to constant illumination the active and quiescent phases were advanced by two months, but for this change the general pattern of activity was the same as that in animals kept under normal photoperiodic conditions. Specimens subjected to total darkness showed a higher level of activity throughout the year in comparison to the other two groups. However, a distinct seasonal cycle, that was evident with normal photoperiods and continuous illumination, was absent in total darkness. (BBB)

43249 RETENTION OF ^{137}Cs IN THE FEMORAL MUSCLE OF RAT AFTER ADMINISTRATION OF KCl AND POTASSIUM ASPARTATE. **Majle, Tadeusz (Zaklad Ochrony Radiologicznej i Radiobiologii, Warsaw). Pol. Tyg. Lek., 23: 425-8(Mar. 18, 1968). (In Polish).**

Wistar rats weighing 140 to 180 g were given a single oral dose of ^{137}Cs and retention of the isotope in femoral muscle was studied 6, 12, 18, 24, 30, 36 hr, 14, 21, and 28 days later. Effects of addition of KCl to the drinking water (1200 mgK/1) or K aspartate (1200 mg K/1) were tested. The experiments were carried out on 270 rats, 90 of which drank water with KCl and 90 others drank water with an equivalent amount of aspartate. The 90 control rats drank distilled water. The rats were killed at the various time intervals and ^{137}Cs activity was measured in muscle sections, the results being subjected to analysis of variance. The results showed that the level of ^{137}Cs in femoral muscles of rats drinking K solutions was lower than in the muscles of rats drinking distilled water. The level of ^{137}Cs was lower in the muscles of rats drinking K aspartate solution than in those drinking KCl solution, particularly in the 14- to 28-day muscle samples. (BBB)

43250 INCORPORATION OF L-THREONINE AND L-METHIONINE IN PLASMA PROTEINS OF IRRADIATED RABBITS. **Mehran, A. R. (Faculte des Sciences, Quebec); Loiselle, J. M. Arch. Int. Physiol. Biochim., 76: 91-102(Feb. 1968). (In French).**

Quantitative changes occur in the plasma proteins of rabbits irradiated with a 1600 R dose, including a decrease in albumins and γ-globulins, and an increase in α- and β-globulins while total proteins show no significant variations. To further examine this phenomenon, rabbits were subjected to an acute irradiation dose of 1600 R, and 24 hr later, the incorporation of radiolabeled constituents of their plasma was measured. Two amino acids, L-threonine-^{14}C and L-methionine-^{3}H which, on the basis of metabolic behavior, are very different one from the other, were used. These two amino acids were administered simultaneously and their degree of incorporation studied in the same animal to facilitate the interpretation of the results. The incorporation of the radioactive amino acids into plasma proteins increased greatly under the influence of irradiation. Therefore, it was concluded that irradiation stimulated the biosynthesis of plasma proteins. (BBB)

43251 EFFECT OF IONIZING RADIATION ON THE IMMUNITY OF SHEEP INOCULATED AGAINST ANTHRAX. **Ivanov, Ivan; Vrigazov, Angel; Surtmadzhiev, Kristo; Stamenov, Boris (Veterinary Inst. of Infectious and Parasitic Diseases, Sofia). Vet. Med. Nauki (Sofia), 2: 629-34(1965). (In Bulgarian).**

In radiation experiments using 180-kV x rays, 23 sheep, two to three yr old, were divided into four groups. In the first group, 10 were sheep immunized against anthrax and one sheep received 150 R, two sheep 200 R, one sheep 250 R, four sheep 300 R, and two sheep 350 R of whole-body radiation. In the second group, the four sheep not immunized and three sheep received 0, 200, 250, and 300 R respectively; all four sheep were later infected with anthrax. In the third group the two sheep immunized against anthrax were not irradiated. In the fourth group of seven sheep, four were immunized and three not immunized; all received 350 R and were not challenged with anthrax. In group I, all sheep manifested radiation sickness as seen by a slight (after one day) to more severe (after three to 10 days) leukopenia. Groups II, III, and IV served as controls, group II for the virulence of anthrax culture, group III for the degree of immunity, and group IV for the blood picture changes with the advancing radiation sickness. In sheep with immunity against anthrax and irradiated with 150, 200, and 250 R, immunity developed and protected the sheep from death after inoculation with a virulent anthrax culture. In sheep immune to anthrax and irradiated with 300 R, the immunity was absent in 50% of the animals, and they died after inoculation with live anthrax bacilli. In sheep immune to anthrax, after irradiation with 350 R the immunity vanished in all of the experimental sheep and they died after inoculation with the virulent anthrax culture. (BBB)

43252 EFFECT OF MONOCHROMATIC BACKGROUND LIGHT ON ROENTGENOPHOSPHENE. **Savchenko. B. N. Nerv. Sist., Leningrad. Gos. Univ., Fiziol. Inst., No. 7, 170-5 (1966). (In Russian).**

Experiments were conducted on young frogs adapted to darkness to determine the effect of monochromatic background light on electroretinogram (ERG) wave b changes with light and roentgen stimuli. ERG were recorded with white, red, and blue monochromatic background lights. Light and roentgen impulses were selected of such values that the amplitude of wave b would be uniform before reaching a plateau. Duration of the light stimulus was 2 sec, and duration of the roentgen stimulus was 2.5 sec with a 1 min interval between the stimuli. Findings show ERG wave b differences in response to roentgen and photostimulation as a result of the monochromatic light acting on the rods and cones. The number of rods acting in a unit of retina surface in response to liminal stimuli differs with monochromatic background lights. Sensitivity of scotopic vision also differs. The darkness adaptation mechanism of the retina appears to be basically a nervous process having practically no connection with the rhodopsin concentration in the photoreceptors. (ATD)

43253 SYNTHESIS OF GLUCURONIC ACID IN VIVO AND IN VITRO AFTER WHOLE-BODY IRRADIATION IN RATS. **Chiriboga, J. (Puerto Rico Nuclear Center, Mayaguez). Acta Physiol. Latinoamer., 18: 31-41(1968).**

The effect of irradiation on detoxification mechanisms, especially glucuronic acid conjugation, was studied and discrepancies found in the in vivo and in vitro results that were compared. Duodenal tissue from whole-body irradiated rats, tested in vitro, showed reduced ability to conjugate anthranilic acid (30% of the control level) 48 hr after irradiation. At 192 hr after irradiation the conjugation was again at the normal level. Glucose added to the medium had no effect on control tissue but increased the conjugation of irradiated tissue. Diphosphopyridine nucleotide increased the conjugation of tissue from normal animals but had no effect on tissue from irradiated animals. Uridine-5′-diphosphoglucose and uridine-5′-diphosphoglucuronic acid had no effect on normal or irradiated tissue. In animals given naphthalene intragastrically or anthranilic acid subcutaneously at different intervals after irradiation with 1000 R, excretion of glucuronic acid was the same as in the controls. Hence, in vivo results indicated that this mechanism of detoxification was not impaired after irradiation at lethal doses. (BBB)

43254 SELECTED REFERENCES TO TRACER TECHNIQUES. REVIEW NO. 1. REVISED EDITION. Wilson, B. J. (comp.). Amersham, Eng., Radiochemical Centre (UKAEA), 1968. 17p.

The references are grouped under the following headings: General texts, labelled compounds—preparation; applications of tracers (general, industrial, biological and medical); measurement (general, scintillation counting, gas counters and ion chambers, respired $^{14}CO_2$ measurements, autoradiography); safety precautions. (U.K.)

43255 INACTIVATION OF YEAST ALCOHOL DEHYDROGENASE BY ULTRAVIOLET LIGHT. Dose, K.; Krause, G. (Max-Planck-Institut fuer Biophysik, Frankfurt am Main). Photochem. Photobiol., 7: 503-6(May 1968).

The inactivation of yeast alcohol dehydrogenase by ultraviolet radiation was assayed in a 0.03 M barbital buffer at 20°C and pH 8.5 by recording the absorbancy increase as a function of time in reduced nicotinamidedinucleotide. Increase of absorption was dose-dependent. (C.H.)

43256 FREE RADICAL INDUCTION BY ULTRAVIOLET RADIATION IN CONSTITUENTS OF DEOXYRIBONUCLEIC ACID. Lacroix, M.; Van de Vorst, A. (Univ., Liege). Photochem. Photobiol., 7: 477-83(May 1968). (In French).

The action of ultraviolet rays of 260 nm on aqueous solutions of bases, nucleosides, and nucleotides of DNA at 77°K was studied by electron spin resonance. It was shown that the free radicals observed are similar, with a few noteworthy exceptions to those induced by x rays, under the same conditions of temperature, in the solid state. Contrary to what might be expected on the basis of the results obtained by x rays, the variation in the yield in paramagnetic centers in each sequence studied did not seem to be important. (auth)

43257 FORMATION OF ERYTHROPOIETIC COLONIES IN THE SPLEEN OF IRRADIATED MICE, FOLLOWING AN INJECTION OF HUMAN HEMOPOIETIC CELLS. Pons, Susetta (CNEN, Casaccia, Italy); Petrakis, Nicholas L. Boll. Zool., 32: 603-12(1965). (In Italian). (RT/BIO-(66)25).

Male C3H/HeJ mice were exposed to 900 rad of x rays. Soon after irradiation, part of the animals were injected intravenously with 0.2–0.5 ml of a suspension containing $1.75 \times 10^5 - 3 \times 10^6$ nucleated bone marrow cells or $1.5 \times 10^5 - 1.75 \times 10^7$ lymphocytes. The control animals were injected with an equal volume of tissue culture medium (TC-199). Eleven days later 25.8% of the animals that received bone marrow cells and 17.8% of the animals which received lymphocytes developed splenic nodules, ranging from 1 to 6 per spleen. Only one nodule was found in 60 control animals. The chromosomal analysis of the cells in the colonies indicated that the colonies were of mouse origin and therefore endogenous. These findings have been interpreted as a consequence of an aspecific stimulus by the injected human cells on the surviving stem cells of the host. (auth)

43258 EFFECT OF TEMPERATURE ON INCORPORATION OF ^{32}P INTO NUCLEOTIDES OF PEA LEAVES. Semikhatova, O. A.; Nikulina, G. N. (Komapov Botanical Inst., Moscow). Dokl. Akad. Nauk SSSR, 173: 1466-8(Apr. 21, 1967). (In Russian).

The appearance of radioactive ^{32}P in nucleotides indicates that on penetrating the cell, ^{32}P becomes involved in phosphorylation processes associated with oxidation reactions in the cell. Thus, an increased temperature should result in an uncoupling of phosphorylative oxidation. Shredded leaves from young pea plants were placed in a radioactive KH_2PO_4 solution containing 1 mg of KH_2PO_4/ml for a period of 2 to 3 hours. After a standard water rinse the leaves were extracted with 10% trichloracetic acid (TCA) at 0°C. The radioactive nucleotides were absorbed onto activated charcoal from the TCA extract, and the activity was determined by counting the charcoal on an end-window Geiger–Mueller counter. The results were expressed in percentage of the amount of activity obtained in the same experiment at room temperature. On increasing the temperature to 42 to 43°C, an intensive incorporation of ^{32}P into the nucleotides was observed, while at 45 to 46°C the incorporation of ^{32}P was very slight. Up to 39°C the respiration of the pea leaves went smoothly without any noticeable decrease over the 2 to 3 hr exposure to the KH_2PO_4 solution. At 41 to 42°C a progressive lowering in respiration was observed. This temperature can be considered as the critical respiration temperature. At 45 to 46°C the respiration was weak after ½ hr. Thus the results show that uncoupling of oxidation and of phosphorylation does not take place at higher temperatures. (TTT)

43259 RETENTION OF INHALED ETHYL IODIDE LABELED WITH ^{132}I. Morgan, D. J.; Black, A.; Mitchell, G. (Atomic Energy Research Establishment, Harwell, Eng.). Nature (London), 218: 1177-8(June 22, 1968).

For a group of seven persons breathing normally, retention of ethyl iodide-^{132}I varied from 44 to 62%. Retention correlated strongly with breathing rate. Urinary excretion of iodide after inhalation of labeled ethyl iodide was also investigated; results indicate that within the body ethyl iodide undergoes decomposition to inorganic iodide at a somewhat slower rate than methyl iodide. The reactions of both iodides with stored human blood in vitro were also investigated. Ethyl iodide reacted about 100 times slower than methyl iodide. (U.K.)

43260 IRRADIATED HETEROTOPIC SEGMENTAL CANINE PANCREATIC ALLOGRAFTS. Merkel, Frederick K.; Kelly, William D.; Goetz, Frederick C.; Maney, John (Univ. of Minnesota, Minneapolis). Surgery, 63: 291-7(Feb. 1968).

In this new vascular technique for the homotransplantation of a segment of the canine pancreas, radiation was used to protect against leakage of secretions from divided and ligated pancreatic ducts. Segmental heterotopic pancreatic homotransplants were carried out in 15 previously pancreatectomized dogs. The donor received 500-R x radiation to the pancreas 3 to 7 days prior to transplantation, and the recipient underwent total pancreatectomy 5 to 10 days prior to transplantation. Heterologous anti-lymphocyte serum proved to be a potent immunosuppressive agent when used alone, and wound healing was not grossly impaired. All the irradiated transplants functioned initially, and glucose tolerance and insulin-stimulating tests revealed good evidence of function from 7 to 42 days. Over one-half of the dogs succumbed with functioning transplants in place. The gross and histologic appearance of the rejected pancreas is described. (BBB)

43261 ARE THE SUBSTANCES PRODUCED DURING THE IRRADIATION OF SUGAR SUBSTANCES OF THE RADIOMIMETIC TYPE? Jonard, Robert; Manant, Pierre; Schaeverbeke, Janine (Faculte des Sciences, Nantes, France. CPEM, Paris). Compt. Rend., Ser. D, 266: 2122-5(May 13, 1968). (In French).

The realization of experiments on vegetable tissues cultivated in vitro made it possible to establish that the radiolysis products of sugars did not contain compounds of the radiomimetic type such as alkylating agents. Prolonged heating produced the same effect on sugars as irradiation. (tr-auth)

43262 STUDIES ON SOME CHEMICAL ENZYMATICAL AND PHYSIOLOGICAL CHANGES IN PLANT MATERIAL CAUSED BY GAMMA-IRRADIATION. Jaarma, M. (Univ. of Stockholm). Ark. Kem., 28: 223-43(1968).

The influence of chronic and acute gamma radiation on plant material was investigated. The results indicate that there is a correlation between the growth inhibition and the sucrose accumulation. Some enzymes involved in the carbohydrate metabolism in potato tubers were isolated and partly purified. No changes in the activities of the enzymes were observed when irradiating them in vivo whereas exposure of the isolated enzymes to the same doses in vitro caused decisive changes. Gamma irradiation was also found to induce changes in concentrations of the free amino acids in the potato tubers. Irradiated tubers and control tubers respectively, including additives of free amino acids, were fed to rats in order to determine whether changes of the free amino acid pool in brain, liver, and blood of the rats could be observed. Haematological examinations were also performed. No significant differences between groups fed the different diets could be noted. In addition, the stimulatory action of very low gamma doses on sprouting of potato tubers was studied. (auth) (Swed.)

43263 DOSIMETRY OF THE RADIOISOTOPES OF COBALT. Barnaby, C. F.; Smith, T.; Thompson, B. D. (Medical Research Council, London). Phys. Med. Biol., 13: 424-33(July 1968).

The retention of ^{60}Co by the whole body and tissues of the rat was investigated for periods up to 132 days following intravenous, intraperitoneal and oral administration. After the first day the retention curves for all tissues except liver can be described by power functions. Long term retention components are present in whole-body, muscle and skeleton. Radiation dose commitments to tissues of the rat, following administration of the cobalt radioisotopes, were compared with ICRP data. A qualitative extrapolation of the results to man indicates that, following intraperitoneal administration of ^{56}Co and ^{58}Co, the liver will be the critical organ, but the pancreas and kidneys will be critical for ^{57}Co and ^{60}Co. The lower large intestine will be the critical tissue following oral administration of cobalt radioisotopes. (auth) (UK)

43264 INDICATIONS TO A MECHANISM OF ADAPTION, MEASURED AT THE DIMINUTION OF MEMBRANE-POTENTIAL OF NITELLA FL. AFTER IRRADIATION. Hansen, U.-P. (Institut fuer Angewandte Physik, Kiel). Atomkernenergie, 13: 60-6(1968). (In German).

Cells of nitella were irradiated by x rays and this was repeated after equal intervals of time (about 10 to 100 min). The maximal value U_n of the depolarization of membrane potential was plotted against the number n or irradiation. The relation between U_n and n called dependence of number is given by: $U_n = (U_1 - U_\infty)q^{n-1} + U_\infty$. The unknown mechanism responsible for it was called anti-reaction and was compared with a control-circuit to get conceptions for analysis. V, s and l describe rise, decay and consumption of the anti-reaction. It vanishes after 12 to 20 hours. For intervals shorter than 20 min another mechanism was observed which enlarges the depolarisation of the 2 irradiation. The dependence of number makes it difficult to get the dose-effect-function. Only the existence of a threshold was stated. (auth)

43265 FREE RADICALS IN CARDING–PASSEY MELANOMA AFTER EXPOSURE TO UNFOCUSED LASER RADIATION. Piruzyan, L. A.; Barsegyan, L. Kh.; Dement'ev, V. A.; Savchenko, G. S. (Inst. of Chemical Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Biol., No. 1, 121-3(1968). (In Russian).

After melanoma irradiation with the unfocused beam of a neodymium laser at doses of 20, 40 and 60 joule, free radical concentrations in exposed melanoma specimens and in the controls differ only within the experimental error. The ESR signal of both irradiated and control melanoma specimens is an asymmetric singlet with the g-factor near 2 and width of ~6-7-gs gauss. Owing to a slight temperature rise (at the depth of 2 mm $\Delta T_{max} \approx 10°$), no histological changes were found in the tumors following irradiation. (auth)

43266 TRITIUM AND ^{14}C COUNTING IN TISSUE SAMPLES BY USING LIQUID SCINTILLATION METHOD. Parekh, C. K.; Eigen, E. (Colgate Palmolive Co., Piscataway, N. J.). Lipids, 3: 225-7(May 1968).

Low activities of tritium in tissue samples are difficult to determine directly by solubilizing the tissue samples in hyamine or NCS base (Nuclear Chicago Corporation, Ill.). The counting efficiency is quite low because of the severe quenching; therefore the labeled tissue samples are combusted and the activity of the resulting tritiated water is determined. The combustion method was modified to increase the recovery of tritiated water. This was accomplished by cooling the bottom of the combustion flask in a dry ice-acetone bath while irradiating the top with an ir lamp. The procedure resulted in at least 92% to 102% recovery of the tritiated water. The NCS solubilizer was found to be superior to hyamine for solubilizing ^{14}C-labeled tissue samples. The samples yielded light yellow solutions when incubated for 15 hr at 50 to 55°C. The counting efficiency of this solution was 75% or higher. (BBB)

43267 THE RADIOIODINE ^{131}I CONVERSION RATIO AND PROTEIN-BOUND IODINE IN ATHEROSCLEROSIS. Janotka, M.; Ondrejicka, M.; Pechan, J. (Comenius Univ., Bratislava). J. Atheroscler. Res., 7: 771-6(1967).

The metabolism of radioiodine was studied in 124 euthyroid normal patients and 53 euthyroid patients with atherosclerosis, particularly the conversion ratio and plasma-protein bound ^{131}I. The conversion ratio was obtained by determining the ratio of protein-bound ^{131}I to the total ^{131}I activity of the serum. The subjects were given 10 μCi of ^{131}I/10 Kg body weight intravenously as sodium iodide. Twenty-four hr later the whole plasma radioactivity was measured. The radioiodine conversion ratio fell with advancing age in both the normal and atherosclerotic groups, but it was much more marked in the atherosclerotic patients, the difference from the normal group being significant. This correlated with the previous finding of a decrease in the ^{131}I uptake capacity of the thyroid gland. The PBI was found to be within the normal range in both elderly normal people and atherosclerotics, although it was slightly lower in the latter group. The discrepancy between the reduced conversion ratio and the normal PBI in old age and atherosclerosis is discussed. (BBB)

43268 EFFECTS OF IONIZING RADIATION FROM ^{60}Co ON OOCYSTS OF EIMERIA BOVIS. **Fitzgerald, Paul R. (Univ. of Illinois, Urbana). J. Parasitol., 54: 233-40(Apr. 1968).**

Development of irradiated vaccine for immunizing cattle against pathogenic coccidia was explored. Sporulated and unsporulated oocysts were γ irradiated at doses of 10,000, 50,000, 75,000, 100,000, or 200,000 rad. Ability of sporulated oocysts to cause coccidiosis in young Holstein–Friesian calves was used to measure the effect of irradiation. Sporulated oocysts irradiated at 10,000 rad caused infection similar to the controls while those irradiated with 50,000 rad caused only mild infections in a few calves. Sporulated oocysts irradiated with 75,000 rad or more did not cause coccidiosis. When previously inoculated calves were challenged with nonirradiated oocysts, only those that had infections caused by oocysts irradiated with 10,000 rad were resistant to reinfection. Thus, infections had to occur before immunity developed. Calves given sporulated oocysts that were irradiated in the unsporulated condition at all doses became infected although calves receiving oocysts irradiated at 200,000 rad were least affected. Calves recovering from infection were resistant to challenge inoculations. Unsporulated oocysts withstood much heavier irradiation with retention of viability than sporulated oocysts. In vitro studies of rates of excystation indicated that irradiation did not adversely affect, but may have enhanced, excystation. Irradiation was not advantageous in attenuating E. bovis for use in immunizing calves. (BBB)

43269 MOLEKULYARNYE MEKHANIZMY BIOLOGICHESKOGO DEISTVIYA RADIATSII VYSOKIKH ENERGII. (Molecular Mechanisms of Biological Effects Induced by High-Energy Radiation). Kuzin, A. M. Moscow, Izdatel'stvo Nauka, 1968. 31p.

Descriptions are given of the structure-metabolic theory of biological effects induced by high-energy ionizing radiation. Concepts of primary radio-chemical processes producing free-radical semiquinonoid and quinonoid radiotoxins are discussed. (56 references are included). (R.V.J.)

43270 RADIOACTIVE XENON (^{133}Xe) DISAPPEARANCE RATES FROM THE SYNOVIAL CAVITY OF THE HUMAN KNEE JOINT IN NORMAL AND ARTHRITIC SUBJECTS. **St. Onge, R. A. (Yale Univ., New Haven); Dick, W. C.; Bell, G.; Boyle, J. A. Ann. Rheum. Dis., 27: 163-6(Mar. 1968).**

Comparison of the rates of disappearance of ^{133}Xe from normal knee joints and from the actively involved knees of patients with rheumatoid arthritis showed that the rates are clearly different. A 10-μCi dose of ^{133}Xe in 1.5 ml. 0.9% NaCl was injected into the knee joint by a lateral infra-patellar approach. The joint was aspirated as fully as possible before the ^{133}Xe was injected. Immediately after injection the patient flexed and extended the knee joint a few times to ensure uniform distribution of radioactivity. Measurements started 2 min after injection and were taken continuously for 30 to 45 min. In all the patients with rheumatoid arthritis a bi-exponential mode of disappearance of ^{133}Xe from the knee joint was observed. When the count rate was plotted at 1-min intervals on semi-log graph paper, there was an exponential (straight line) component to the curve beginning ~15 min after injection. A semi-log plot of the difference between the straight line and the points recorded during the first 15 min or so of the experiment are shown. The second semi-log plot again describes a fairly straight line. The biological half-life was calculated for each of the two exponential functions; $T\frac{1}{2}$ referred to the biological half-life of the slower component of the bi-exponential curve and $T'\frac{1}{2}$ to the biological half-life of the faster component. In the knees of six patients the mean and standard error of $T\frac{1}{2}$ was 38 ± 5.17 min and for $T'\frac{1}{2}$ 3.4 ± 0.35 min. The findings in all the subjects with normal knees differed from those observed in these arthritic patients. Normal subjects displayed a monoexponential disappearance rate. The mean $T\frac{1}{2}$ was much slower (217.85 ± 22.6 min; range 66 to 630). This mean value was significantly different from that of the patients with rheumatoid arthritis. (BBB)

43271 ABSORPTION OF BARIUM SULFATE AND CHROMIC OXIDE FROM THE CHICKEN GASTROINTESTINAL TRACT. **Vohra, Pran; Kratzer, F. H. (Univ. of California, Davis). Poultry Sci., 46: 1603-4(Nov. 1967).**

The absorption of ^{133}Ba (as $BaSO_4$) and ^{51}Cr (as Cr_2O_3) from the gastrointestinal tract of 5-week-old chickens was studied, as well as the distribution of ^{133}Ba and ^{51}Cr in the following tissues: liver, heart, kidney, pancreas, spleen, gastrointestinal tract, including the crop and the vent, and left tibia. An average of 97.75 ± 2.85% of $^{133}BaSO_4$ and 87.55 ± 2.70% of $^{51}Cr_2O_3$ was excreted in 48 hr after a single dose of these compounds. It was thought that the recovery of ^{133}Ba and ^{51}Cr was of approximately the same order although the differences between 87.55 and 97.75% were significant at the 2% level. The specific activity in various tissues such as heart, kidney, pancreas, liver, and blood was of the same order. However, both of these radioisotope compounds were not completely inert because some activity was found associated with the tissues. Most of the activity not found in the excreta was found associated with the gastrointestinal tract and its washings even after 48 hr. (BBB)

43272 EFFECT OF IONIZING RADIATIONS ON VITAMIN K IN PURE SOLUTION. **Fauchet, M.; Marnay-Gulat, C.; Gounelle, H. (Centre Recherche Foch, Paris). Nutr. Dieta, 10: 143-50 (1968). (In French).**

Previous studies on the irradiation of beef to prolong its storage life have indicated that doses in the radiopreservation range (2 to 5 Mrad) may destroy some of its vitamin K content. Animals fed such irradiated beef may show symptoms of vitamin K deficiency, such as increased levels of prothrombin, hemothorax, and subcutaneous hemorrhages. To investigate whether and to what extent vitamin K in pure solution was destroyed by irradiation, the coagulating activity of the vitamin was studied by the biological method of Raoul and Hanna in the deficient rat. Samples of 20 mg vitamin K_1 in 1 ml of water were irradiated with ^{60}Co. The coagulation rate was restored to normal by the parenterally administered vitamin, with little difference according to whether it had been irradiated with a dose of 1 to 5 Mrad or not. However, changes in the color and absorption spectrum after irradiation with 5 Mrad showed that vitamin K was radiosensitive to a certain extent. The absorption spectrum of the vitamin irradiated at 5 Mrad showed an increase of optical density at 245 mμ compared with the nonirradiated vitamin. (BBB)

43273 TUMOUR REOXYGENATION DURING FRACTIONATED RADIOTHERAPY; STUDIES WITH A TRANSPLANTABLE MOUSE OSTEOSARCOMA. van Putten, L. M. (Radiobiological Inst., TNO, Rijswijk, Netherlands). Eur J. Cancer, 4: 173-82(May 1968).

The oxygenation status of transplantable mouse osteosarcoma C22LR was studied from the radiation dose survival curves. Cell suspensions were prepared from this tumor and the radiosensitivity of both the suspensions in vitro and the tumor in situ were determined by endpoint dilution assay. From these survival curves, the mean anoxic cell fraction in the tumor in situ was 14%. After four daily doses of 250 rad to the tumor, the anoxic cell fraction rose to 32% and two days after a single dose of 1000 rad 88% anoxic cells were found. A calculation of the fractions of surviving cells showed that little or no reoxygenation of previously anoxic cells occurred in this tumor after the preferential elimination of oxygenated cells by radiation. This contrasts markedly with earlier observations for another tumor and it seems likely that different tumors may differ in their capacity to reoxygenate anoxic cells during fractionated therapy. Since this capacity was calculated to be most important in determining the radiation dose needed to cure a tumor, a difference in reoxygenation may well be responsible for a large part of the variation in curability by radiotherapy between different tumors. (auth)

Ecology

Refer also to abstracts 43306, 43311, 43356, and 43698.

43274 (TID-24597) ACCUMULATION AND TRANSFER OF RADIOSTRONTIUM BY YOUNG LOBLOLLY PINES. **Dayton, Bruce Roy** (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). 1968. Contract AT(38-1)-310. 64p. Dep. CFSTI.

Thesis. Submitted to Univ. of North Carolina, Chapel Hill.

A study was conducted to quantify transfer and accumulation of radiostrontium by young loblolly pines on the Savannah River Plant, South Carolina. Stems of seven trees were each inoculated with 3 mCi of radiostrontium. Accumulation of radiostrontium in foliage continued for 13 months after inoculation, when a maximum of 1265 mCi per tree was attained. The prolonged period of accumulation in foliage was attributed to the influence of ion exchange on translocation and to the long life span of needles.

There was little evidence of basipetal translocation of radiostrontium to roots. About two percent of the maximum foliage burden of radiostrontium was released by leaching during the 16 months of the study. Transfer of leached radiostrontium to the ground by rainwater flowing down stems was only 23 percent of that transferred by rainwater falling through tree crowns. Twenty percent of the maximum foliar uptake was released by needles falling from the trees. The inoculated pines accumulated three times more radiostrontium in foliage than they released by needle fall and leaching. At the conclusion of the study, radiostrontium was distributed in the ecosystem in the following manner: 51 percent in stems and branches, 38 percent in needles, 10 percent in litter and less than one percent in soil, roots and understory. Ninety-four percent of the radiostrontium released from the inoculated trees was in litter. In 16 months only 4.6 percent of total radiostrontium released from foliage was transferred to mineral soil. Ground cover under the inoculated trees, primarily the litter, accumulated 20 times more radiostrontium than it released. Although much of the radiostrontium transferred to soil was confined to the top 2.5 cm where feeder roots are most abundant, less than 10 percent of the radionuclide accumulated in soil was in roots. Accumulation in soil and roots closely approximated input from needle fall and foliar leaching, indicating that release from roots of basipetally translocated radiostrontium was negligible. Little or no transfer out of the system by leaching to subsoil, runoff, or blowing away of litter was detected. In young pine stands, the increasing amount of litter added each year and the slow release to mineral soil would lead to a rapid accumulation of radiostrontium in litter and underlying organic matter. The radiostrontium burden of a pine forest contaminated by a pulse of radioactive fallout might be reduced considerably by removal of litter after peak needle fall. (auth)

43275 MEASUREMENT OF RADIONUCLIDE UPTAKE BY ALGAE. Porter, N. S.; Hoitink, N. C.; Cushing, C. E. (Pacific-Northwest, Richland, Wash.). pp 159 of Proceedings of the 19th Annual Conference on Engineering in Medicine and Biology, San Francisco, California, November 14–17, 1966. Volume 8. Vurek, Gerald G. (ed.). New York, Institute of Electrical and Electronics Engineers and Pittsburgh, Instrument Society of America, 1966.

See CONF-661119.

Genetics and Cytogenetics

Refer also to abstracts 43208, 43224, 43237, 43298, 43384, 43481, 43490, and 44963.

43276 (UCSF-10-P-2-39, pp 52-124) RADIATION GENETICS. (California Univ., San Francisco. Lab. of Radiobiology).

Three papers are presented in this section discussing chromosome aberrations and strandedness, and tritium-tracer studies of chromosomes. In the first paper, the effects of cell phase on the type of chromosome aberrations induced by x rays in root tip cells from Vicia faba are discussed. It was found that although variations did occur with cell phase, there was no effect from prior irradiation on these aberrations, nor was there any correlation between type of aberration and cell death. The discussion of strandedness is a resume of the observational, experimental, and inferential evidences regarding the single- or double strandedness of chromosomes. The preponderance of the cytological evidence indicates that most chromosomes are not single stranded. Existing models of single stranded chromosomes suffer from the same conceptual difficulties that the multistranded models do. Two chromosome studies with tritium-labeled thymidine are discussed in the third paper. In the first study it was found that sister strand exchanges occurring in tritium-labeled chromosomes were induced by the β decay of the tritium and were dose independent. The dose-independent nature of the exchange mitigates against a purely spontaneous explanation for the event. In the second study, tritium-labeled metaphase chromosomes were studied to determine whether chromatid segregation into daughter cells was random or nonrandom. The evidence indicated that the segregation was indeed random. (E.R.B.)

43277 RELATION BETWEEN POLYPLOIDS AND RADIOSENSITIVITY OF OOCYTES OF ARTEMIA SALINA LEACH. Ballardin, E.; Metalli, P. (CNEN, Rome). Boll. Zool., 32: 613-18(1965). (In Italian). (RT/BIO-(66)24).

A schematic description of the macroscopic events of Artemia salina oogenesis and the associated cytological stages of meiosis is given, as the necessary biological background to the technique of sampling homogeneous cells at known maturation stages for irradiation experiments. A summarized report on the results so far collected indicates that: the tetraploid oocytes are more resistant than the diploids by a factor of three to four, as estimated by the slope of the exponential part of the dose-effect curve (hatchability inhibition); the shoulder width for the tetraploids is twice as large as for the diploids; prometaphase (or diakinesis) oocytes, and metaphase oocytes as well, are more resistant than oocytes in earlier stages of the maturation division; by dose-fractionation experiments it was estimated that the prometaphase (or diakinesis) oocytes were able to repair about one half of the repairable damage, the latter estimated on the dose-effect curve; the repair efficiency is the same for all strains and ploidies tested, therefore the greater resistance of the tetraploids is not correlated with a greater recuperation ability; the absolute amount of damage that an oocyte can repair is, however, correlated with the degree of ploidy, being twice as large in the tetraploids, and it is directly correlated with the shoulder width; the time to reach maximum recuperation varies from 15 min to four hr. according to the strain, which suggests that different repair mechanisms may be operative in the different genotypes. (auth)

43278 CHROMOSOME DAMAGE INDUCED BY RADIATION. Langlands, A. O. (Medical Research Council, London. Western General Hospital, Edinburgh); Smith, P. G.; Buckton, Karen E.; Woodcock, Gillian E.; McLelland, J. Nature (London), 218: 1133-5(June 22, 1968).

Quantitative variations in the yield of ring and dicentric chromosomes were found in cultures of peripheral blood lymphocytes taken from patients after whole-body x-irradiation in the dose range 17 to 50 RADs. (auth) (UK)

43279 EFFECTS OF β-RAYS FROM ^{32}P, ^{35}S, AND X-RAYS ON ROOT TIP ANAPHASE IN JUTE: CORCHORUS OLITORIUS L. AND C. CAPSULARIS L. Das, A. (Bose Inst., Calcutta). Trans. Bose Res. Inst. (Calcutta), 29: 119-22(Dec. 1966).

Three varieties of Corchorus olitorius, viz. C. G., R-26 and T. M. (Tall Mutant), and one variety of Corchorus capsularis, viz. D-154, were treated with different doses of radioactive phosphorus (^{32}P) and sulphur (^{35}S). Studies on anaphase chromosomes of treated material showed that the variety D-154 was more resistant to radiations than the other three varieties. The anaphase abnormalities in the root tips were higher in groups treated with ^{32}P than in those treated with x rays and ^{35}S. (auth)

43280 ON THE KNOWLEDGE OF THE CHROMOSOMAL ABERRATIONS MECHANISM. Mitrofanov, Yu. A.; Titov, E. K.; Olimpienko, G. S.; Shavel'zon, R. A.; Burykina, A. P. (Inst. of General Genetic, Moscow). Genetika, 4: No. 7, 5-16(July 1968). (In Russian).

The induction of reparation system enzymes by preliminary irradiation was observed in experiments with Crepis capillaris. This phenomenon may account for certain effects observed in radiobiology, such as the effect of fractionation and the dose-rate effect. The enzymes of the reparation system did not modify the spectrum of chromosome aberrations; therefore they functioned at the level of the potential chromosome damages. Stages of open chromosome breaks were never observed in the course of initiation of aberrations when such inhibitors as actinomycin, chloramphenicol or propylgallate were used. This fact, as well as the initiation of almost exclusively two-break aberrations as the result of irradiating the cells at the stage G_1, suggested that the interaction of the two chromosome threads was an indispensable prerequisite for the formation of chromosome aberrations. The rare occurrence of terminal chromosome deletions was explained as the result of incomplete exchanges taking place in the course of formation of chromosome aberrations. Sister interochromatid exchanges (SIE) resulted in single rings when the chromosomes were irradiated at the stage G_1. SIE's took place after chromosome splitting at the stages G_2 or S, i.e., at the chromatid level. The possible role of the sister interchromatid exchanges in the process of formation of aberrations is discussed. (auth)

43281 THE EFFECT OF THE X-RAY FRACTIONATED DOSE ON THE CHROMOSOME ABERRATIONS YIELD IN CREPIS CAPILLARIS. I. IRRADIATION AT THE G_1-STAGE. Generalova, M. V. (Inst. of General Genetics, Moscow). Genetika, 4: No. 7, 17-23(July 1968). (In Russian).

The effect of x-ray fractionated dose of the chromosome aberrations yield in Crepis capillaris was studied. Crepis capillaris cells were exposed to irradiation at the G_1-stage. Data confirming the hypothesis about the occurrence of chromosome breaks within certain limits of time were obtained. The time factor depended on the stage and was equal to 60 to 80 minutes. At a dose of 800 R the yield of 2-hit aberrations coincided with the base line after the fractionation effect was attained, while at doses of 1200 R and 1600 R it decreased somewhat but never exceeded the base line. The discrepancy between the aberration yield at the high-dose radiation and with that expected theoretically (below the total dose level at short intervals and below the base line at long ones) was probably associated with the increase of life of the chromosome broken ends. (auth)

43282 THE INFLUENCE OF THE GENOTYPE ON THE FREQUENCY OF RADIATION-INDUCED ANEUPLOIDY IN THE OOGENESIS OF DROSOPHILA MELANOGASTER. V. A TENTATIVE EXPLANATION OF THE DIFFERENCES IN THE DOSE-RESPONSE CURVES. Glotov, N. W. (Inst. of Medical Radiology, Obninsk, USSR). Genetika, 4: No. 7, 24-9(July 1968). (In Russian).

In the previous papers of this series, the dose-response curves were presented for the frequencies of the radioinduced occurrence of exceptional flies in the progenies of females of six different strains of *D. melanogaster* showing diverse spontaneous frequencies of exceptional progeny. In order to explain the unusual dose-response dependence in y/y sc^{S1} In 49 v sc^8/Y females the following quantitative hypothesis was proposed: assume that the γ radiation at a dose D results in the prohibition of the chromosomal non disjunction in cells with the probability α. Then if the non-disjunction is still possible (its probability being $1 - \alpha$), it will occur with the frequency p(A) composed of the spontaneous frequency inherent in the given particular strain plus β, the frequency of the non-disjunction induced by the dose D. Then at the dose D the observed frequency of exceptional females p(B) will be: $p(B) = p(A) - \alpha \cdot [p(A) + \beta] + \beta$. If the six strains used in this work differed from one another only in the frequency p(A) while the values of α and β were solely dose-dependent, then there should exist such values of α and β that would convert into identity the equations of the system $P_i(B) = P\cdot(A) - \alpha[p\cdot(A) + \beta] + \beta$; $i = 1, \ldots, 6$. By means of the solution of systems of two equations for each of the dose levels for the strains yellow and y/y sc^{S1} In 49 v sc^8/Y very similar values of α and β for all the doses were obtained. The substitution of these values into the corresponding equations for other four strains gave values that were in satisfactory agreement with the experimental data. The methods of checking, the weak points, and the consequences of the hypothesis proposed are discussed. (auth)

43283 THE CHANGE OF THE SPECTRUM OF AUXOTROPHIC MUTATIONS IN ESCHERICHIA COLI B BY THE COMBINED ACTION OF HYDROXYLAMINE AND DIFFERENT DOSES OF ULTRAVIOLET RAYS. Panfilova, Z. I.; Salganik, R. I. (Inst. of Cytology and Genetics, Novosibirsk, USSR). Genetika, 4: No. 7, 108-13 (July 1968). (In Russian).

It was established that a momentary treatment with hydroxylamine at different periods of the logarithmic growth stage of a population of *Escherichia coli* B after the synchronization induced auxotrophic mutations, diverse but definite at each period. Thus, in a culture that had attained an optical density (OD) up to 0,11 units there appeared arginine-ornithine- and threonine-deficient mutants; after the culture had attained an OD up to 0,165, hydroxylamine induced proline-deficient auxotrophs; in the cultures with an OD up to 0.2, phenyl-alanine-alanine-deficient auxotrophs, and in those with an OD up to 0,22 leucine-deficient mutants prevailed. The irradiation of the population of *E. coli* B at doses of 100 and 200 erg/mm^2 did not increase the yield of mutants. It was established that the irradiation of *E. coli* B at a dose of 100 erg/mm^2 after the treatment with hydroxylamine extended the spectrum of auxotrophic mutations, while the irradiation at a dose of 200 erg/mm^2 extended the spectrum of the mutagenic action of hydroxylamine still wider. Thus, if hydroxylamine treatment induced the phenyl-alanine-alanine-deficient mutants, after an additional uv irradiation at a dose of 100 erg/mm^2 there also appeared some proline, leucine- and glycine-deficient auxotrophs; when the population was irradiated at a dose of 200 erg/mm^2 the appearance of mutants requiring purines and methionine was observed. The data are discussed in light of the concept of the local denaturation of DNA during physiological replication, as the result of uv irradiation, and also of the higher sensitivity of the denaturated DNA to certain chemical mutagens. (auth)

43284 A COMPARATIVE STUDY OF THE NUCLEOTIDE COMPOSITION OF DNA AND RNA IN THE SEEDS OF THE RADIOMUTANTS OF COTTON AND OF THEIR INITIAL FORMS. Nazirov, N. N.; Perepelenko, S. D. (Inst. of Experimental Plant Biology, Tashkent). Genetika, 4: No. 7, 165-7(July 1968). (In Russian).

The data obtained in a comparative investigation of the total nucleotide composition of DNA and RNA in the seeds of various radiomutants of cotton and of their initial forms are presented. No significant differences between the mutants and the initial forms in the nucleotide composition of the nucleic acids were observed. (auth)

43285 SIMILARITIES AND DISPARITIES BETWEEN X-RAY INDUCED CELL-KILLING AND THE PRODUCTION OF CHROMOSOMAL ABNORMALITIES IN MAMMALIAN CELLS: A CELLULAR FRAME OF REFERENCE FOR EVALUATION OF LONG-TERM RADIATION EFFECTS. Berry, R. J. (Churchill Hospital, Oxford). pp 89-103 of Radiation and Ageing. Lindop, Patricia J. (ed.). London, Taylor and Francis Ltd., 1966.

From International Colloquium on Radiations and Ageing, Semmering, Austria, June 23–24, 1966. See CONF-660635.

Argon, present at high pressure during x irradiation of mammalian cells, was shown to protect against the production of chromosome abnormalities. In vitro and in vivo experiments with three cell lines did not show similar protection against radioinduced cell killing. This suggested that reproductive cell death and chromosome abnormalities are not produced by the same mechanism following irradiation. The results are discussed with reference to radioinduced tumors. (M.M.B.)

43286 RECOVERY OF MAMMALS FROM LATE RADIATION EFFECTS. Curtis, H. J. (Brookhaven National Lab., Upton, N. Y.). pp 105-16 of Radiation and Ageing. Lindop, Patricia J. (ed.). London, Taylor and Francis Ltd., 1966.

From International Colloquium on Radiations and Ageing, Semmering, Austria, June 23–24, 1966. See CONF-660635.

Studies of chromosomal aberrations in liver cells of mice showed that a very important part of the late effects of radiation are due to the production of mutations in somatic cells. These and other studies showed that there is a great deal of recovery from radiation damage, and in any organ this can be either by cell selection at the time of cell division, by chromosomal repair in interphase cells, or both. The available radiation mortality data for both mice and men were reviewed in an effort to relate these recovery processes to recovery of the whole animal. There is no doubt that there is recovery from radiation-induced leukemia. It is not possible to make similar unequivocal statements for the other degenerative diseases, but the available data strongly suggest that recovery takes place provided the animal lives long enough. There is a hint that recovery processes may be more effective in man than in mice. (auth)

43287 CREATION OF MUTATION BY HEAVY WATER (D_2O) IN A STREPTOMYCIN-DEPENDENT STRAIN OF PROTEUS MIRABILIS. Jung, K. (Inst. for Stable Isotopes, Leipzig). Z. Allg. Mikrobiol., 8: 1-8(1968). (In German).

The mutations created by heavy water in the str-d-3 strain of *Proteus mirabilis* were investigated with especial reference to the strain-dependence → strain-independence mutation step as the selection criterion for the quantitative measure of the mutation creation. Deuterium oxide inhibited the growth of the strain investigated; and the culture was adaptable to heavy water. The heavy water increased the abundance of the emergence of a streptomycin-independent variety. Both the regular and the mutant variants were inhibited in their growth by heavy water. (JPRS)

43288 RECOMBINATION BETWEEN BACTERIOPHAGE ϕ170 AND OTHER RELATED PHAGES. Iijima, Teiji; Sakamoto, Yutaka (Inst. for Fermentation, Osaka). Idengaku Zasshi, 43: 43-8(Mar. 1968).

Defective phages ϕ170dg recombined with the related phages λ, 434, 82, or ϕ80 when one of the related phages was superinfected to a defective lysogenic strain ϕ170dg, or when a doubly lysogenic strain (ϕ170dg)(ϕ) was induced with uv irradiation. The resulting particles having the immune specificity of ϕ170 always had the host range of the colysogenizing phage, that is, ϕ170hy type. When a defective lysogenic strain was spotted on a hetero-immune indicator, the recombinant type phage was responsible to form a lytic zone. The recombination was also confirmed by using various λsus mutants. In lysates prepared from doubly lysogenic strain (ϕ170dg)(λsus) contained both ϕ170hy and ϕ170hysus, or ϕ170hysus alone according to the sus markers used. From the recovery of the sus markers among ϕ170hy particles, the defective region of ϕ170dg was assumed. Defective region of a given ϕ170dg was also assumed by complementation test, using Pm$^-$ (ϕ170dg) and various λsus mutants. From the results obtained by these methods, similarity of arrangement of genetic markers on the chromosome of λ and ϕ170 was assumed. (auth)

43289 THE USE OF INDUCED SOMATIC MUTATIONS TO STUDY CELL DIVISION RATES IN IRRADIATED STAMEN HAIRS OF TRADESCANTIA VIRGINIANA L. Ichikawa, Sadao; Sparrow, Arnold H. (Brookhaven National Lab., Upton, N. Y.). Idengaku Zasshi, 43: 57-63(Mar. 1968). (BNL-11898).

Inflorescences of *Tradescantia virginiana* L. HV Purple Dome (2n = 24), heterozygous for flower color, were exposed to 100 to 500 R of ^{137}Cs γ rays over a 16 hr period. Stamen hairs from both irradiated and unirradiated flowers were observed daily for 26 days after irradiation, and number and position of the somatic mutations (blue to pink) induced in the stamen hair cells were recorded. Somatic mutations were induced at a rate of 4.75×10^{-4} mutant events per meristematic hair cell per R in the essentially single meristematic-cell system. Using the mutant cells as markers it was estimated that the

γ rays induced mitotic delay, lengthened cell cycle time, and impaired normal reproductive integrity. The effect increased with increasing exposures. The average daily increase in number of hair cells per terminal mutant event varied from 2.6 after 100 R to 0.56 after 500 R. The average mitotic cycle times estimated also varied from 17.5 hours after 100 R to a maximum of 80 hours after 500 R, an increase of approximately 4.6-fold in cycle time. However, the length of the mitotic cycle approached the control rate even after 500 R after about 15 days. (auth)

43290 THE MAGNITUDE OF THE PHOTOSYNTHETIC UNIT IN NORMAL GREEN PLANTS AND IN CHLOROPHYLL DEFICIENT MUTANTS. **Wild, Aloysius; Egle, Karl (Univ., Frankfurt am Main). Beitr. Biol. Pflanz., 43: 455-88(1966). (In German).**

The mutant Chlorella pyrenoidosa C-1.1.10.36 that was induced by uv irradiation is characterized by reduced quantities of total chlorophyll and chlorophyll b, as compared to the original strain. These vary according to the light intensity used and the amounts of glucose added to the solution of cells. Although this mutant has a higher CO_2 fixing capacity, after mixotropic culture it scarcely grows in inorganic nutrient solution. Apparently, this is because the chlorophyll is destroyed in the young autospores by the effect of the light, so that the small amount of pigment that remains is insufficient for growth and reproduction of the cells. In mixotropic cultures this defect is overcome by incorporation of glucose, and conditions are established so that additional pigment can be formed. The mutant chlorophyll has a definitely increased photosynthetic capacity. The size of the photosynthetic unit is less than 106 chlorophyll molecules, and there are ~700,000 pigment units. In the normal plant the photosynthetic unit contains from 250 to 300 chlorophyll molecules. The ratio of chlorophyll in normal as compared to the mutant is 5.3 : 1 and the ratio of photosynthetic units is ~1.7 : 1. (BBB)

43291 ON THE AEROPHYTIC GROWTH OF A MUTANT CHLORELLA. **Wild, Aloysius; Egle, Karl (Univ., Frankfurt am Main). Beitr. Biol. Pflanz., 42: 471-7(1966). (In German).**

The growth characteristics of mutant strain 73 of Chlorella vulgaris induced by treatment with ^{32}P and ^{35}S were compared to normal strains. The mutant appeared to have greater tendency to adhere to the surfaces of the glass container. Consequently, relatively fewer of the mutant organisms were found suspended in the solution volume. This decrease was greater than the enhancement of growth produced by spore formation. The main growth of the mutant took place outside of the nutrient solution on the walls of the container. The initial concentration of cells for the mutant and two normal strains was 44,000 cells/ml. After 12 days of growth in the culture solutions the cell counts of the normal strains were between three and 56 million/ml, but the cell counts in the mutant cultures were between 26,000 and 1.2 million/ml. (BBB)

43292 INDUCED MUTATIONS IN QUANTITATIVE CHARACTERS: EXPERIMENTAL BASIS FOR MUTATIONS TO HARDINESS IN CITRUS. **Gregory, Walton C.; Gregory, M. Pfluge (North Carolina State Univ., Raleigh). Contract AT(40-1)-2909. Soil Crop Sci. Soc. Fla., Proc., 25: 372-96(1965).**

Dosimetry tests indicated that fresh seeds and vegetative buds of Citrus had similar levels of tolerance to high energy radiation. Despite the fact that citrus tissue is seldom or never fully dormant in the sense of winter buds or dried seeds, maximum doses near 10 kR of x rays may be delivered in a single continuous treatment. Tests were made for alterations in resistance of Citrus to winter temperatures hundreds of miles north of its present northernmost production in eastern United States. The environment of the test site was chosen to represent winters in which repeated depressions in temperature lethal to Citrus occurred but which did not present so severe a climate as to ensure temperatures far below the lethal range for the material being tested. A further requirement of the test site was a summer environment providing at least 3,000 degrees total heat above the minimum temperature for cell replication in Citrus. Preliminary observations suggest the possibility for a positive test for change in winter hardiness of Citrus. (TSS)

43293 HETEROKARYON SYNTHESIS AND MORPHOGENESIS IN VERTICILLIUM. **Heale, J. B. (Queen Elizabeth Coll., London). J. Gen. Microbiol., 45: 419-27(Dec. 1966).**

Lucerne auxotrophs of Verticillium albo-atrum were produced by uv irradiation. The auxotrophs were isolated after irradiation of a water suspension of conidia at a distance of 20 cm from 2537 Å Hanovia bactericidal tube at 30-sec intervals from 1 to 4 min. Plates showing ~ 5% survival were selected for their yield of mutants. As a result of uv irradiation, germination was markedly delayed in surviving conidia, particularly at the higher doses. The total yield of auxotrophs was $\sim\frac{1}{200}$ at 5% survival. Auxotrophs derived from the same parental strain formed heterokaryons on minimal agar 4 to 5 weeks after inoculation. A degree of heterokaryon incompatibility was shown between auxotrophs derived from different isolates of V. albo-atrum and one of V. dahliae. Conidial methods of heterokaryon synthesis failed but transference of agar inocula from complete medium agar cultures to minimal medium agar was successful. Conidia were uni-nucleate and nuclear migration subsequent to germ-tube fusion was observed. Heterokaryons grew slowly and were unstable, but by using di-auxotrophs a greater stability was achieved and some were subcultured successfully for more than a year. Spore analysis yielded colonies of both parental types with various ratios. A heterokaryon test between a hyaline and normal dark auxotroph of V. albo-atrum indicated that an important system controlling morphogenesis might be linked with a cytoplasmic factor. A hypothesis is proposed to account for the production and degree of stability of the hyaline variants. (BBB)

43294 INDUCTION OF MUTATIONS BY CHRONIC GAMMA EXPOSURE OF RICE PLANT GROWING WITHOUT FERTILIZING. Yamaguchi, Hikoyuki (Tokyo Univ.). Radioisotopes (Tokyo), 17: 382-7(Aug. 1968).

To determine whether the mutagenic effect of γ radiation could be changed by raising plants without application of fertilizers, rice plants were chronically irradiated (85 days) until maturity was attained. Seed fertility, panicle formation, and chlorophyll synthesis were mutation frequencies that were checked. Results showed that fertilizer had no significant effect on the γ-radiosensitivity of rice plants. (B.S.L.)

43295 SEX RATIO OF MICE AS POSSIBLE INDICATOR OF MUTATION RATE FOR SEX-LINKED LETHALS. **Verley, Frank A.; Grahn, Douglas; Leslie, Wayne P.; Hamilton, Katherine F. (Argonne National Lab., Ill.). J. Hered., 58: 285-90(Nov.-Dec. 1967).**

Conflicting results have been obtained on the effect of ionizing radiation on the sex ratio in mice. The need for a reliable estimate of both the spontaneous and radioinduced mutation rates for sex-linked recessive lethal genes in mice is demonstrated by the failure of the available data to yield consistent results. Knowledge of the spontaneous rate is particularly desirable as it would provide a reliable basis for comparing the effects of radiation and other mutagenic agents. A study was conducted to test the sensitivity of a method of estimating the spontaneous mutation rate to recessive sex-linked lethal genes in mice. The method was based on the theoretical expectation that the presence of a sex-linked lethal gene in the female parent will decrease the sex ratio among the progeny produced. Data were available on the sex ratio at birth of 15,000 litters from 2445 single pair matings in 6 inbred strains, A/He, A/Jax, BALB/c, $C3H_f$/He, C57BL/6, and C57L, and 3 hybrids. The method tested proved insensitive for the sample size available. The matings tested showed a subnormal variation for mean sex ratio and no detectable incidence of recessive sex-linked lethal genes. The method was not recommended because the sensitivity of the test was greatly reduced by the subnormal sex-ratio variance. (BBB)

43296 COMPARISON OF THE GENETIC EFFECT OF GAMMA RAYS AND NEUTRONS ON BARLEY SEED. Leroy, P. Pereau (Centre d'Etudes Nucleaires, Cadarache, France). Radiat. Bot., 8: 239-44(June 1968). (In French).

Genetic effects of cobalt-60 γ-rays were compared with neutrons on the basis of chlorophyl mutations induced in barley seed, variety Piroline. Neutron irradiations were performed with a flux of fast neutrons in a reactor cavity equipped with a uranium converter, or with a thermal flux in the swimming pool of a low power reactor. Progeny of treated seeds was investigated for three generations for mutation frequency, spectra and segregation ratio. It was confirmed that neutrons have a greater mutagenic efficiency than γ-rays for the same survival of M_1 plants, but significant differences in the spectra of chlorophyll mutations at the second and third generations were not observed. (auth) (UK)

Health Physics and Safety

***Refer also to abstracts** 42866, 42874, 42938, 42945, 42956, 43014, 43036, 43077, 43130, 43155, 43201, 43233, 43263, 43354, 43356, 43360, 43364, 43374, 43380, 43498, 43506, 43519, 43523, 43519, **and** 44851.*

43297 (AAEC/TM-448) RESUSPENSION OF BERYLLIUM OXIDE POWDER. **Warren, T. J. H.; Copland, J. K. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr. 1968. 24p. Dep.**

A series of experiments to examine the resuspension of beryllium oxide powder under various disturbance conditions is described. With powder deposited on a floor surface, basic disturbance actions were sweeping and walking, and other parameters included ventilation rate. Resuspension factors in the breathing zone ranged from 0.05×10^{-3} m^{-1} to 14×10^{-3} m^{-1}. An analysis of the results leads to a recommendation that a resuspension factor of 7×10^{-4} m^{-1} be used as a basis for determining Maximum Permissible Levels of beryllium surface contamination. (auth)

43298 (AD-666713) USE OF CHROMOSOME ABERRATIONS TO ESTIMATE X-RAY AND GAMMA-RAY DOSE TO MAN. Technical Report, September 1965–August 1966. Norman, Amos; Sasaki, Masao; Ottoman, Richard E.; Veomett, Robert C. (California Univ., Los Angeles. School of Medicine). Dec. 1967. Contract AF41(609)-2944. 24p. (SAM-TR-67-112). CFSTI.

The frequency of chromosome aberrations in lymphocytes taken from the peripheral blood provides a useful measure of absorbed dose. The estimation of dose is affected by time in culture of the lymphocytes, by sampling error and sampling time, and by size, rate, distribution, and quality of radiation dose. Data on the effect of these variables are presented. Dose is estimated for five people accidentally exposed to ionizing radiation. Four appendices give a detailed account of optimal technics for making chromosome preparations, the yields of aberrations as a function of dose in 50-hour and 72-hour cultures, and the yield of acentric fragments per dicentric. (USGRDR)

43299 (AECL-1027(5th Ed.)) HEALTH AND SAFETY ORGANIZATION. Fifth Edition. (Atomic Energy of Canada Ltd., Ottawa (Ontario)). July 1968. 43p.

A summary of the provisions for health and safety, in particular radiation safety, at Atomic Energy of Canada Limited is presented. Such matters as derivation of legal authority, establishment of policy, assignment of operational responsibility and provision of expert advice for management are discussed. Standard Policies and Procedures define the terms of reference of some of the committees and panels mentioned in the report. New terms of reference for all such groups will be published in the same way. These will be the authoritative texts for operating purposes. (auth)

43300 (AERE-PR/HPM-12) HEALTH PHYSICS AND MEDICAL DIVISION PROGRESS REPORT, JANUARY–DECEMBER 1967. Johnston, J. E. (ed.) (Atomic Energy Research Establishment, Harwell (England)). Feb. 1968. 54p. Dep. CFSTI. UK 12s. 0d.

Studies described include the following: Calibration of proportional counter for measuring soft X-rays from ^{239}Pu in lung, using volunteer subjects who inhaled aerosols labelled with ^{103}Pd; Small proportional counter for personnel neutron dosimetry; Exit or doorpost monitor for reactor areas; Exposure of personnel criticality dosimeters to simulated criticality excursions (at ORNL); Technique of radiation spectrometry coupled with automatic data processing and computing; Deposition of fallout ^{137}Cs and ^{90}Sr; Rate of exchange of air between northern and southern hemispheres from analysis of fission product ratios; and Relationships between physical and biological effects of radiation. RBE of monoenergetic neutrons (0.12 to 14.7 MeV) in experiments with *Tradescantia occidentales*: Effects of delta rays (low energy electrons) on inactivation of ribonuclease; Metabolic studies with whole body counter (^{226}Ra, ^{90}Sr, ^{133}Ba, ^{231}Pa, ^{227}Ac, ^{228}Th, ^{59}Fe, ^{137}Cs); Revision and simplification of analytical methods used in bioassay; Production of labelled monodisperse aerosols in size range 0.1 to 10μ for inhalation studies; Absorption of tritium on metal surfaces, its removal, and percutaneous transfer; and efficiency of smear sampling; and Transport of tritiated water vapor and ^{212}Pb vapor to rough surfaces, and effect of molecular diffusivity. Effect of shape on electric mobility of submicron particles; Production of ammonium sulphate particles in air and other gases on irradiation with alpha particles; Dependence of air/water partition coefficient for iodine on redox potential, pH and iodine concentration (reactor aerosol field); Thermodynamic investigation of chemically stable forms of fission products in liquid sodium, including liquid/vapor partition coefficient of iodine; Automatic air sample counter with simple data input and printed output; and Use of cascade centripeter and personal air samplers to determine size and activity distributions of radioactive aerosols. Transportable X-ray spectrometer to measure spectra from diagnostic machines, and computer programme for converting pulse height distributions to photon spectra; Fully automatic film densitometer and associated computer program; Data processing program for recording of haematological records; Use of radioactive asbestos to study translocation and leaching of fibers injected into experimental animals; Uptake of iron preparations in bread; and Neutron activation analysis of calcium in vivo. (UK)

43301 (AERE-R-5474) THE DETERMINATION OF RADIONUCLIDES IN MATERIALS OF BIOLOGICAL ORIGIN. Proceedings of a Symposium held at A.E.R.E., Harwell, 20th and 21st April 1967. Holmes, A. (ed.) (Atomic Energy Research Establishment, Harwell (England)). Oct. 1967. 218p. (CONF-670446). Dep. CFSTI. UK 29s.

Preprints of the following papers presented at the Symposium are included, together with a summary of discussions arising from the papers: Method for determination of ^{14}C in urine, E. J. Marsh and N. A. Taylor (AWRE, Aldermaston); Determination of radionuclides in environmental monitoring samples, H. T. Neville (AEE, Winfrith); Determination of gross alpha activity in urine by adsorption on glass fiber filter paper, J. D. Eakins and P. J. Gomm (AERE, Harwell); Determination of plutonium, enriched and natural uranium in faeces, M. E. D. Bains (AEE, Winfrith); High sensitivity determination of plutonium and uranium in fresh water, G. A. Bogie and N. A. Taylor (AWRE, Aldermaston); Rapid method for determination of ^{237}Np in urine, J. C. Dalton (U.K.A.E.A., Windscale); New method for determination of ^{241}Am in urine, J. C. Dalton; Method for estimation of thorium isotopes in materials of biological origin, D. Gvozdanovic (Medical Research Council, University of Leeds); Two-channel method of evaluating a total absorption peak, R. J. May (Central Electricity Generating Board); New approach to autoradiography in the life sciences, E. I. Hamilton (Radiological Protection Service, Survey); Use of gel suspensions in scintillation counting of low energy beta emitters in bioassay, F. J. Sandells (AERE, Harwell); Study of concentrations of ^{226}Ra and ^{228}Th in the living environment, S. M. Gvozdanovic, T. R. Overton, F. W. Spiers (Medical Research Council, University of Leeds); Accuracy in low level radiochemical analysis, D. Merten and G. Wortley (IAEA, Vienna); Dry ashing, sample temperature and rate of oxidation, T. E. F. Carr (Medical Research Council, Harwell); and Automation in radioisotope analysis of biological materials, Preliminary report, N. A. Taylor, E. J. Marsh, C. A. Bogie (AWRE, Aldermaston). (U.K.)

43302 (CONF-671063-1) NEW APPROACHES TO INDUSTRIAL HYGIENE IN BERYLLIUM FABRICATION. Hedges, Don L. (North American Rockwell Corp., Los Angeles, Calif.). [1967]. 7p.

From Aeronautic, Space Engineering and Manufacturing Meeting, Los Angeles, Calif.

Methods are discussed for air sampling in beryllium fabrication industry in order to comply with Atomic Energy Commission standards for radiation doses to personnel. Criteria are also established for medical history and examination of personnel before hiring in beryllium fabrication industry. (E.R.B.)

43303 (LA-DC-9056) AIR SAMPLING WITH PLASTIC BAGS. Eutsler, B. C.; Campbell, E. E. (Los Alamos Scientific Lab., N. Mex.). [nd]. 9p. (CONF-670937-3). Dep. CFSTI.

From American Industrial Hygiene Association of the Rocky Mountain Section, Albuquerque, N. Mex.

The use of plastic bags for in-plant air sampling is investigated. Mylar bags which hold approximately 14 liters were tested. The bags were filled with air and then injected with the contaminant to be tested. The air sample was then transferred to an infrared cell or gas chromatograph and tested. Test results, including storage losses, for various compounds are presented. (W.H.K.)

43304 (NP-17517) STUDY OF X-RAY RADIATION FROM DENTAL APPARATUS IN ISRAEL. Donagi, A.; Shalmon, E.; Fishel, D. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Feb. 1968. 15p. Dep.

A study of dental x-ray machines and radiation protection practices in Israel was made to determine the present status as a first step towards the establishment of routine countrywide supervision of x-ray machines. A five percent random sample of the dentists and dental practitioners was taken. Detailed questionnaires, covering most of the physical characteristics of dental x-ray machines and the operating procedures employed, were prepared and filled out by a competent staff of interviewers during visits to radiation installations. The inspection routine closely followed that adopted by the U. S. P. H. S. The results are analyzed and recommendations suggested. The survey indicates that a large number of the dental x-ray machines in Israel are defective and involve excessive radiation exposure, mainly to patients. The average size of the central radiation beam is relatively large and the need for its reduction is obvious. The urgency of enacting comprehensive regulation of x-ray machines is pointed out. (auth)

43305 (NYO-2753-6) ^{90}Sr LEVELS IN THE DIETS AND BONES OF CHILDREN. Progress Report, 1968. [Beninson, D.; Ramos, E.] (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). June 2, 1968. Contract AT(30-1)-2753. 63p. Dep. CFSTI.

Determination of skeletal turnover rates and strontium to calcium discrimination factors was continued. The new data confirm previous values of turnover rates and strontium to calcium discrimination factors in the very young (0–2 yrs) and allow a very substantial improvement of estimates of these parameters in the 3–12 yrs age range. Additionally, a first estimate of discrimination and turnover is made for older ages. The values of turnover rates and discrimination factors obtained are used in an evaluation of the dose incurred by people of different age groups in the case of acute or chronic diet contamination. Measurements of ^{90}Sr and stable strontium in food items were continued. Strontium-90 levels in total diet of several age groups were estimated from these measurements and the diet structures presented. Measurements of ^{226}Ra/Ca ratios were carried out routinely in bone samples and in food items. Data on food items, obtained so far, were used in an estimation of total diet levels for several age groups. (E.R.B.)

43306 (NYO–3446-11(App.)) THE OCCURRENCE OF ^{55}Fe IN THE BIOSPHERE AND ITS ENRICHMENT IN HUMANS, ESPECIALLY IN THE LAPPS. Jaakkola, Timo (Helsinki Univ. (Finland). Dept. of Radiochemistry). [1967]. Contract AT-(30-1)-3446. 95p. (In English and Finnish). Dep. CFSTI. Thesis.

In the large nuclear tests of the United States and the Soviet Union during 1961 and 1962 large amounts of the ^{55}Fe isotope were produced. As a result, increases in the ^{55}Fe content of lichens were noticed from the fall of 1962 onwards, reaching its maximum value, 75 nCi/kg fresh weight, during 1964. The effective halftime of ^{55}Fe in lichen was 1.4 years. The ^{55}Fe content of reindeer meat reached its maximum value about a year later (1965) at 7.5 nCi/kg fresh wt, and its biological halftime 110 to 140 days. The ^{55}Fe content of the Lapps' blood in the spring of 1966 was 25 nCi/liter for women, and 17 nCi/liter for men, corresponding to the whole body count ^{55}Fe values of 180 nCi and 120 nCi, respectively. The whole body values obtained for the southern Finns in January 1966 were about ten times smaller than those for the Lapps, that is, 15 nCi ^{55}Fe. Concentrations of inactive iron in the lake water samples analyzed varied within the limits of 0.013-3.67 mg/liter. The ^{55}Fe contents of the fish samples taken from any one lake varied within 3–51 pCi/mg Fe (about 0.001-0.3 nCi/kg meat, fresh weight). The highest activity levels were recorded in lakes where the concentration of inactive iron was low. The ^{55}Fe levels between different species of fish in a given lake varied greatly. The specific activity of ^{55}Fe in trout caught in Inarinjärvi Lake in summer 1966 was 13.2 pCi/mg Fe (about 0.05 nCi/kg meat, fresh wt) and in whitefish 6.2 pCi/mg Fe (about 0.02 nCi/kg meat, fresh wt). The ^{55}Fe content of a trout caught in Tenojoki river and analyzed to determine the ^{55}Fe content of the Utsjoki Lapps' diet, was 17 nCi/kg fresh weight, and the ^{55}Fe content of the meat of a *Gadus garbonarius* and a flaunder caught in the Arctic Ocean was 0.73 and 0.45 nCi/kg fresh weight, respectively. The specific activity of ^{55}Fe (pCi/mg Fe) in the blood of Lapp women in spring 1966 was 75 to 100% of the specific activity of ^{55}Fe in their food. The specific activity of ^{55}Fe in the blood of Lapp men was 40 to 50% of the level in their diet. The whole body count of ^{55}Fe in Lapps was 0.1 to 0.25% of the maximum ICRP maximum permissible level that for members of the general population is 100.000 nCi. When the ^{55}Fe content of Lapp's blood was 50 pCi/mg Fe, the yearly dose to the blood tissue was 2.6 mrad. Since the main part of the radiation is absorbed by the red blood cells, the annual radiation dose, calculated for this restricted iron rich tissue, is 19 mrad for the Lapps and 2 mrad for the southern Finns. (auth)

43307 (ORNL–4286) HEALTH PHYSICS AND SAFETY ANNUAL REPORT FOR 1967. (Oak Ridge National Lab., Tenn.). Aug. 1968. Contract W-7405-eng-26. 90p. Dep. CFSTI.

The gaseous and liquid waste releases from the Laboratory were such that the concentration of radioactive materials in the environs was well below the maximum levels recommended by the NCRP and FRC. The average concentration of radioactive materials in the atmosphere at the X-10 site and the calculated average concentration of radioactive materials in the Clinch River at the point of entry of White Oak Creek into the river were both less than one percent of the maximum permissible. No employee received an external or internal radiation dose that exceeded the maximum permissible levels recommended by the FRC. No employee has a cumulative whole body dose that exceeds the recommended maximum permissible dose as based on the age proration formula 5(N-18). There were no cases of internal exposure where the deposition of radioactive materials within the body was estimated to have averaged greater than one-half of a maximum permissible body burden. During 1967, there were 16 unusual occurrences recorded, which is the lowest number recorded since the present system of reporting unusual occurrences was established in 1960. During 1966, there were 22 occurrences recorded. The Laboratory reported four disabling injuries during 1967, which was a frequency rate of 0.50. (auth)

43308 (ORNL-TM-2249) ESTIMATING EXTERNAL DOSE IN FEASIBILITY EVALUATIONS OF PLOWSHARE EVENTS. Plowshare Research and Development Quarterly Progress Report, April 1–June 30, 1968. Kaye, Stephen V.; Rohwer, Paul S. (Oak Ridge National Lab., Tenn.). Aug. 1968. Contract W-7405-eng-26. 18p. Dep. CFSTI.

A brief description is given of the EXREM computer code for calculating dose equivalent rates and dose equivalents from external β- and γ sources of radioactivity that might result from nuclear engineering detonations. Three modes of external exposure are considered: (1) submersion in contaminated air, (2) submersion in contaminated water, and (3) exposure above a contaminated surface. This code will handle up to 25 releases of radioactivity involving up to 250 radionuclides and two locations for each mode of exposure. (auth)

43309 (ORNL-tr–1963) DEPTH DOSES OF FISSION NEUTRONS IN TISSUE-EQUIVALENT MATERIAL. David, Lubomir. Translated for Oak Ridge National Lab., Tenn., from Jad. Energ., 13: 241-5(1967). 12p. Dep. CFSTI.

Accurate knowledge of fluence-dose relation is needed in neutron monitoring for radiological protection. In this paper, fluence-dose conversion factors for the depths of 0, 5, 10, 20, and 30 cm in an infinite slab of tissue-equivalent material are given and their dependence on neutron energy over the range 0,1 keV to 10 MeV is determined. In addition, average values of these conversion factors for fission neutron spectrum as a function of its threshold energy are calculated and intercomparisons of several activation integrators as to their efficiency of measuring fast neutron tissue-doses are discussed. (auth)

43310 (PHS–999-RH-29) TRITIUM CONTAMINATION IN PARTICLE ACCELERATOR OPERATION. Nellis, Donald O.; Hudspeth, Emmett L.; Morgan, Ira L.; Buchanan, Patricia S.; Boggs, Richard F. (National Center for Radiological Health, Rockville, Md.). Nov. 1967. 47p. Public Health Service, Washington, D. C. Free.

Tritium-metallic targets are frequently used in many particle accelerators for the production of high-energy neutrons. The problems and hazards associated with the use of these tritium targets are investigated so that appropriate steps can be taken to minimize the potential radiological health hazards. Particular emphasis is placed on the operation of Cockcroft-Walton neutron generators, since these constitute a high percentage of such particle accelerators which utilize the tritium-metallic targets. This study shows that bombardment of tritium targets results in the loss of about 1 tritium atom for each bombarding deuteron, and that most of the tritium is in a gaseous form when it leaves the target. It was also determined that a relatively small amount of the tritium released from the target actually remains within the accelerator itself. Most of the tritium lost by a bombarded target is trapped in the elements of an ion pump or released through the vacuum system exhaust. (auth)

43311 (PRNC–85) MARINE BIOLOGY PROGRAM. Progress Summary Report No. 4, June 1965–June 1966. Lowman, F. G.; Phelps, D. K.; Ting, R. Y.; McClin Escalera, R. (Puerto Rico Nuclear Center, [Mayaguez]). Apr. 1966. Contract AT(40-1)-1833. 361p. Dep. CFSTI.

The amounts of the trace elements iron, manganese, cobalt, copper, nickel, chromium, zinc, cadmium, strontium, lithium, lead, rubidium, scandium, samarium, and the major elements potassium, calcium, and magnesium were determined in marine organisms, sea water, seston, and marine sediments as well as selected rocks, minerals and soils of the Culebrinas, Añasco, and Guanajibo River valleys. Temporal and geographic variations in stable element content in algae, benthic infauna, and plankton are being investigated. The nature of the distribution patterns of stable elements within the biogeochemical environments is being determined. The amounts of trace elements in organisms were related to ash, wet and dry weights, and to organic carbon and nitrogen. Uptake experiments are being conducted using ^{182}Ta, ^{24}Na, and ^{65}Zn in selected marine algae. A study of ^{65}Zn uptake by different size groups of the marine algae *Penicillus capitatus* and *Udotea flabellum* is being investigated. Studies on the distribution patterns of ^{65}Zn, and other radioisotopes, between the cell sap and the plant surface of the large single-cell alga, Valonia, were started. The effects of bacteria upon the apparent uptake of ^{65}Zn by benthic algae were measured under normal and sterile conditions. Observations on the accumulation patterns of ^{110}Ag by the spiny lobster, *Anulirus argus*, were started. Uptake studies of ^{65}Zn at different trophic levels in infaunal invertebrates were initiated in the laboratory. Stable element analyses were incorporated into a study of the partitioning of iron, scandium, zinc, and samarium within a benthic infaunal community. A description of the biogeochemistry of scandium within the Añasco River, its watershed, and Añasco Bay was completed. Investigations were started on the trace element content per gram of carbon and nitrogen in the food web *Thallasia*→*Tripneustes* *esculentus*→*Cassis* *flammea*. This year the trace elements will also be related to caloric content in the three trophic levels. Another study is in progress on the trace element relations in the food web; benthic *detritus*→*Mulinea* and *Tellina* (clams)→*Luidia* *senegalensis* (starfish). The ^{14}C method was used to measure biological productivity. Analyses were made to determine specific activity of ^{14}C in the total carbonate of sea water and in phytoplankton. ^{14}C was measured by β counting. Biological productivity was related to species diversity with depth; geographical location, total carbon and nitrogen, and will be related to caloric values in mixed phyto-zooplankton. These parameters, as well as the lipid and amino acid patterns in zooplankton, are being considered in relation to the trace and macro-element composition of the two trophic levels and the physical environment. Bottom profiling and observations of salinities, temperatures, turbidities and currents are continuing. A study of distribution of marine sediments by clastic properties was begun. Rates of sedimentation were determined through vertical distributions of seston corroborated with geological studies. A method for identifying water masses in zones of mixing between coastal areas and the open ocean was developed through determination of stable element ratios characteristic of the particulate fractions in the water masses. Investigations on the distribution patterns of calcite, aragonite, and α quartz in the marine sediments off the west coast of Puerto Rico are in progress. The determination of the biogeochemistry of the rare earths is of practical importance in the consideration of hazards from the fission-product rare earth radioisotopes. Methods were developed in which stable lanthanum, europium, and samarium may be measured in large numbers of samples. With additional effort cerium, holmium, and other rare earth elements may also be determined. (E.R.B.)

43312 (RA-34) ^{90}Sr AND ^{137}Cs IN THE HUMAN DIET IN THE NETHERLANDS DURING 1967. Mattern, F. C. M.; Drost, R.; Strackee, L. (Rijks Instituut voor de Volksgezondheid, Bilthoven (Netherlands). Laboratorium voor Stralingsonderzoek). June 1968. 28p. Dep.

Results of measurements of ^{90}Sr and ^{137}Cs in a number of foodstuffs are reported. The yearly mean of the daily dietary intake of ^{90}Sr and ^{137}Cs in the Netherlands is estimated as 12.1 and 47 pCi/day respectively. (auth)

43313 (RISO-170) INVESTIGATIONS ON THE PLANT UPTAKE OF FISSION PRODUCTS FROM CONTAMINATED SOILS. I. INFLUENCE OF PLANT SPECIES AND SOIL TYPES ON THE UPTAKE OF RADIOACTIVE STRONTIUM AND CAESIUM. Andersen, A. J. (Danish Atomic Energy Commission, Risoe. Research Establishment). Nov. 1967. 32p. Dep.

Results of pot experiments on the uptake of radioactive Sr and Cs by different plant species are presented, and comparisons are made between the uptake figures registered on some representative Danish soils. The uptake of radioactive Sr varied considerably between plant species and could be evaluated from their Ca uptake. The $^{89}Sr/Ca$ ratio varied between different parts of the same plant, being relatively high in the roots of root crops and low in seeds and fruits. The ^{89}Sr uptake from different soil types decreased with increasing content of exchangeable Ca in the soils. The ^{137}Cs uptake varied between plant species and could be reduced by potassium fertilization. The uptake from different soil types generally decreased with increasing clay content, but also the content of organic matter influenced the plant availability of ^{137}Cs. (auth)

43314 (RISO-174) INVESTIGATIONS ON THE PLANT UPTAKE OF FISSION PRODUCTS FROM CONTAMINATED SOILS. II. THE UPTAKE OF RADIOACTIVE STRONTIUM PLACED AT DIFFERENT DEPTHS IN THE SOILS. Andersen, A. J. (Danish Atomic Energy Commission, Risoe. Research Establishment). Dec. 1967. 19p. Dep.

The possibility of reducing the plant accumulation of ^{90}Sr by deep ploughing of the contaminated soil was investigated in experiments with different crops grown in microplots. The ^{90}Sr was placed at different levels in the soil profile, and the uptake by barley, rye-grass, red clover, and root crops was measured. As compared with superficial application, placement of strontium at a depth of 40 to 45 cm reduced the ^{90}Sr content of the crops by a factor of two to five according to the soil type. Placement at a depth of 80 to 85 cm as compared with 40 to 45 cm caused only a very small difference in the uptake. The downward movement of the ^{90}Sr was very slow. Almost all the strontium remained within the 20 cm soil layer in which it was applied. (auth)

43315 (RMRC/P-17) TRANSPORT OF MICRON-SIZED DROPLETS TO VERTICAL SURFACES. Wells, A. C.; Chamberlain, A. C. (Atomic Energy Research Establishment, Harwell (England)). Feb. 1965. 8p. Dep. CFSTI. UK.

The transport or deposition of micron-sized particles on vertical surfaces is studied. The apparatus used in the investigation is described, and the theory of transport of small particles is discussed. Data are presented on the transport of one micron droplets for various surfaces. (W.H.K.)

43316 (UCRL-17933) HEALTH AND SAFETY GUIDE. (California Univ., Berkeley. Lawrence Radiation Lab.). June 1968. Contract W-7405-eng-48. 86p. Dep. CFSTI.

Topics discussed include medical services, occupational health plan, emergencies and first aid, accelerator radiation safety, maximum permissible exposures, and personnel monitoring. Also, safety services are discussed including radioisotope control, permissible exposure, radiation incidents, fire safety, industrial safety, and industrial hygiene and toxicology. (W.H.K.)

43317 FIRST STATEMENT OF SEVEN YEARS OF RESEARCH ABOUT THE LEVELS OF ENVIRONMENTAL AND FOOD CHAIN CONTAMINATIONS BY RADIOACTIVE FALLOUT ON THE FRENCH TERRITORY. Pellerin, P.; Remy, M. L.; Ervet, P.; Moroni, J. P. Bull. Inst. Nat. Sante Rech. Med., 22: 357-82 (1967). (In French). (SCPRI(S)-115).

Data collected since 1959 by the Central Service for Protection against Ionizing Radiations are presented. Radioactive contamination of the principal food chain links (plants, milk, bones) from fallout was analyzed at seven reference stations located within distinct climatic areas. Contamination of milk by ^{90}Sr and ^{137}Cs for the 95 French Departments was measured between 1962 and 1966. Body burdens resulting from food chain contamination were determined. Maps are presented to represent data with relation to space and time. (H.L.W.)

43318 INDUSTRIAL MEDICAL EXPERIENCE ASSOCIATED WITH THE PALOMARES NUCLEAR INCIDENT. Odland, Lawrence T. (Air Force Logistics Command, Wright-Patterson AFB, Ohio); Farr, Robert L.; Blackburn, Kenneth E.; Clay, Amon J. J. Occup. Med., 10: 356-62(July 1968).

Industrial, medical, and bioassay experiences associated with the Palomares nuclear accident indicate that, in spite of the many handicaps of field operations, personal protection and decontamination procedures were effective. Of nearly 1,700 participants, less than 20% had a systemic body burden of ^{239}Pu detectable by urine studies, and of this number, only 26 showed a value in the range of 7 to 67% of one permissible body burden, the rest all had a value of 6% or less. Extensive follow-up studies on the 26 people over a period of nearly one year supported the conclusion that, based on available methods for estimation of systemic body burden of plutonium following an inhalation exposure, not one individual who participated in the Palomares operation demonstrated a systemic long-term retention in amounts exceeding the maximum permissible. (auth)

43319 CENTRAL AXIS DEPTH DOSES FOR A CONSTANT SOURCE-TUMOUR DISTANCE. Saunders, J. E.; Price, R. H.; Horsley, R. J. (Ontario Cancer Treatment and Research Foundation, Hamilton). Brit. J. Radiol., 41: 464-7(June 1968).

Some aspects of central axis depth dose calculations for treatments with a constant source tumor distance are considered. It is shown that errors, of about 2 percent for ^{60}Co γ rays, may be introduced when using tissue air ratios and tissue phantom ratios in certain central axis dose calculations. By introducing a modified definition of tissue-phantom ratio, these errors are eliminated. (auth)

43320 A CASE OF ACCIDENTAL INHALATION OF ^{231}Pa AND ^{227}Ac. Newton, D. (Atomic Energy Research Establishment, Harwell, Eng.). Health Phys., 15: 11-17(July 1968).

The behavior of accidentally inhaled protactinium-231 and actinium-227 was followed over the period 7 to 900 days after intake, using a single large sodium iodide detector placed close to the chest. The results could be explained by a long-term clearance from the thorax involving biological half-lives of 1000 ± 300 days and 300 to 400 days respectively. There was negligible migration of actinium-227 daughters from the chest. (UK)

43321 GUIDES LIMITING THE RELEASE OF RADIONUCLIDES BY THE SAVANNAH RIVER PLANT. Evans, A. G.; Marter, W. L.; Reinig, W. C. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Health Phys., 15: 57-65(July 1968).

The Savannah River Plant has developed Plant Release Guides to define the amount of various radionuclides that can be released to the environment in air and water. Releases are held to the lowest practicable level within Plant Operating Guides based on careful operation, and are well below the Radiation Protection Guides recommended by the Federal Radiation Council for neighboring populations. (UK)

43322 SURVEY OF ENVIRONMENTAL DOSE EVALUATIONS. Honstead, J. F. (General Electric Co., Richland, Wash.). Contract AT(45-1)-1830. Nucl. Safety, 9: 383-93(Sept.-Oct. 1968). (BNWL-SA-1573).

Environmental dose calculations are used as a basis for evaluating environmental surveillance data. Dose evaluations are consistent with the recommendations of the Federal Radiation Council (FRC) and the International Commission on Radiological Protection but are not now required by the regulations governing the operation of nuclear facilities. This means of judging the radiological condition of an environment is most helpful to those sites releasing complex mixtures of radionuclides and having a multitude of possible pathways back to man. Hanford is the only U. S. site at which regular annual dose evaluations are published. A detailed study of the dietary pathways originating with Clinch River water is used at Oak Ridge National Laboratory as a means of assessing dose-level changes. The following benefits might be derived from dose evaluations at more U. S. sites: demonstration of the FRC range appropriate for each site; optimization of the scope of environmental monitoring programs; assurance that any environmental reconcentration processes will be detected; and ready accommodation of new sources of exposure in the environment. (auth)

43323 AN AUTOMATIC FRACTIONATOR FOR LIGHT DOSAGE ON THE SKIN. ITS APPLICATION TO THE POLYCHROMATIC MINIMAL ERYTHEMA DOSE. Findlay, G. H. (Univ. of Pretoria, S. Afr.). Brit. J. Dermatol., 79: 148-52(Mar. 1967).

A simple and inexpensive uv light dosimeter for use on the skin is described, that has some advantages over existing devices that serve the same purpose. It was used in clinical tests to demonstrate the uv erythema spectrum in human skin. Eighty-four graded doses could be administered in a short time, permitting a maximum of 12 different sorts of light test, or a lesser number of controls of the same test if required. Experimental checks showed that the fractionation of unfiltered uv light was achieved and that fractional doses at a given narrow wave band were close to the values calculated from the manufacturer's data. The 24-hr threshold erythema dose was determined with the unfiltered light in each adult subject. The dose given over each 10 mμ from 250 to 320 mμ was calculated from the measured quantity of light received at the skin surface, the threshold time in seconds, and the percentage of the light emitted in each such 10 mμ band, the dose given being expressed in mW sec cm^2 per 10 mμ for threshold erythema. It was shown that a Xe lamp produces sunburn principally through uv wavelengths not present in sunlight. The subjective and objective changes from multiple erythema doses from the lamp differed also in various ways from that of natural sunburn. There was less scatter of the threshold values with polychromatic light than with monochromatic light. The combined threshold uv dose agreed with the single threshold dose for each wave band; therefore, subthreshold summation of doses over different parts of the erythema spectrum does not occur, and an all-or-none type of erythemal response might operate at threshold level and below it. (BBB)

43324 SOME MEASUREMENTS ON THE SLOWING DOWN OF π MESONS IN TISSUE-EQUIVALENT MATERIAL. Sullivan, A. H.; Baarli, J. (CERN, Geneva). Phys. Med. Biol., 13: 435-41(July 1968).

Measurements of the attenuation of positive and negative pion beams are described. An analysis is made of the results, and it is estimated that the average energy locally deposited in a tissue-equivalent absorber by a strong interaction of a negative pion is 19.6 ± 1.3 MeV. At the negative pion beam absorption peak it is shown that the absorbed dose from nuclear interactions amounts to about 45% of the total dose. (auth)

43325 RADIATION HYGIENE AND PRACTICE IN DENTISTRY. J. Amer. Dent. Ass., 76: 107-16(Jan. 1968).

It is estimated that approximately 95,000 x ray units are in use in dental offices in the United States at the present time. Approximately 60% of the states have adopted mandatory regulations regarding the use of radiation in dentistry, and over 90% of the states either require registration of dental x ray units or have general radiation codes. Data on regulations of the 50 states, the District of Columbia, and Puerto Rico are presented, with general information on state administering agencies, requirements of inspection, record maintenance, equipment standards, structural shielding standards, operating procedures, and radiation protection standards applicable to the use of radiation in dentistry. (C.H.)

43326 RADIOACTIVITY OF VEGETABLES. Muminov, M. M.; Maksudov, U. (Samarcand State Univ., USSR). Dokl. Akad. Nauk Uzb. SSR, No. 11, 24-5(1967). (In Russian).

Beta-radioactivity of the most common vegetables (potatoes, carrots, onion, radishes, and turnips) in the Samarcand district was investigated. Tabulated data indicated β activity for ^{40}K and natural radiation. (R.V.J.)

43327 EXPERIENCES OF HYGIENIC SURVEY AT THE INSTITUTE OF NUCLEAR RESEARCH AT REZ. Chysky, J. (Research Inst. of Radiation Hygiene, Prague). Jad. Energ., 14: 216-19(July 1968). (In Czech).

The preliminary part contains the results of measurements of personal exposures of the workers at the Institute of Nuclear Research at Řež, the results of aerosol measurements at the individual working places, activities of fluid wastes, activities of gasses discharged through the ventilation chimney and a brief survey of results of the workers' internal contaminations. In the following part the applied measuring and checking methods are briefly analyzed from the hygienic point of view. The experience of the Institute's almost ten-year activity is, on the whole, favorable. According to the results of the applied checking methods, the working hazards do not differ from those experienced at other places manipulating with sources of ionizing radiations. Likewise, the surroundings have been found to be free of any negative effects due to the Institute's operations. However, in evaluating the present experience, it should be noticed that the checking methods have not always been fully satisfactory from the hygienic point of view, and that the operations at some Institute's departments have only been starting to develop fully within the last few years. In the final part the defects are demonstrated which occurred during the designing and construction of the Institute. The necessity is stressed of an active cooperation of the users, designers, health workers and other experts in the designing and construction of nuclear establishments. (auth)

43328 TRITIUM MEASUREMENTS IN RADIATION PROTECTION. Maushart, R. (Kernforschungszentrum, Karlsruhe, Ger.). G-I-T(Glas.-Instrum.-Tech.), Fachz. Lab., No. 9, 845-52(Sept. 1967). (In German). (KFK-677).

Tritium, apart from the multi-curie sources used in radiation technique, is the most frequently used radioisotope. Due to its low energy (maximum energy = 18 keV), this nuclide demonstrates substantial problems of measuring technique. Tritium is incorporated as water vapor and will show in an extremely short interval in the blood. This is one more reason why its importance in radiation protection should not be underestimated. Apart from some specific properties of tritium, the paper discusses special measuring procedures, comparing them to their specific aptitudes. (auth)

43329 CHOICE OF EQUIVALENT MATERIALS FOR DOSIMETRIC MEASUREMENTS. Sinitsyn, R. V. (Central Scientific-Research Inst. of Roentgen-Radiology, Leningrad). Med. Radiol., 13: No. 2, 20-4(1968). (In Russian).

A description is given of the method of calculating the composition of materials that mimic other materials in absorption and scattering of ionizing radiation, that for certain causes could not be utilized directly: walls of ionization chambers, tissue-equivalent phantoms, equivalent absorbers, etc. The evolved method of calculation is based on the mathematical apparatus of linear programming and enables, in each instance on the grounds of the substances handy, to select the most optimal composition of the equivalent substance. Theoretical computations are illustrated on the example of phantom calculation modeling the absorption in the muscular tissue. (auth)

43330 RADIATION LOADING IN LARGE-FRAME FLUOROGRAPHY. Shtuss, A. A.; Burman, V. L.; Mazarskii, I. Z. Med. Radiol., 13: No. 3, 79-82(1968). (In Russian).

Complex fluorographic investigation comprised eight records fluorograms of the lungs, esophagus, and stomach. Measurements were made of the initial exposition doses in the region of gonads and in the direct ray of the VFK-3 photodosimeter with Agfa film. Subject to determination was the estimation and integral dose of the whole organism, and the absorbed gonad dose. It was established that the whole-body dose of the radiation loading in complex fluorography is significantly lower than in roentgenoscopy of the lungs, esophagus, and stomach. It is as follows: the skin dose in direct ray is two to four times greater, the total integral absorbed dose is two times greater, the absorbed integral dose is almost two times greater, the absorbed gonad dose in men increases by 14%, and in women by six to seven times. (auth)

43331 METABOLISM AND PROGNOSIS OF ^{137}Cs RADIATION DOSES. Malykhin, V. M.; Shamov, V. P. Med. Radiol., 12: No. 9, 58-61(Sept. 1967). (In Russian).

Determination of ^{137}Cs γ irradiation doses in vivo was achieved by an indirect method involving evaluation of dosimetric parameters. The radioactivity of daily secretions was measured. Evaluation of the levels and comparison of the ^{137}Cs radiometric sensitivity in biological specimens was carried out using Q (Greenfield) criterion and classifications according to the difficulty of measurement: fast (demanding an accuracy of $E = 10\%$ with duration not exceeding 1 min); ordinary ($E = 10\%$, $T < 15$ min) increased ($E = 20\%$, $T \leq 1$ hr); and long duration ($E = 30\%$, $T \leq 4$). The four types of difficult measurements are characterized by the quality parameter range: $100 < Q$ (min^{-1}), $6.5 < Q < 100$, $0.42 < Q < 6.5$, and $0.05 < Q < 0.42$. The tabulated activity indicated for measuring an increased and long duration activity enabled evaluation of ^{137}Cs isotope content and dosage with the accuracy of the order of 70%. The magnitude of the single uptake of ^{137}Cs into the organism tested using the urine specimen taken after 10, 40, 100, 200, and 365 days was analyzed. (R.V.J.)

43332 CALCULATION OF DOSES ABSORBED BY THE CRITICAL ORGANS OF MEDICAL PERSONNEL IN X-RAY ROOMS. Golikov, V. Ya. (Central Medical Graduate School, Moscow). Gig. Sanit., No. 5, 60-5(May 1968). (In Russian).

A method is described for the calculation of radiation doses absorbed by medical personnel of x ray departments. (auth)

43333 EFFICIENCY OF SKIN DECONTAMINATION FROM ^{210}Po. Efimova, A. N.; Vorob'ev, A. M.; Khodyreva, M. A.; Izergina, A. G. (Inst. of Biophysics, Moscow). Gig. Sanit., No. 5, 114-16(May 1968). (In Russian).

It was found that under identical conditions of polonium contamination, unithiol (2,3-dimercapto-1-propanesulfonic acid) was the most effective decontaminating agent. Methods and materials for cleaning the hands of personnel handling polonium in a laboratory were studied experimentally. Soap, pumice stone, triton, soda, sodium diethyl dithiocarbamate, thio urea, and unithiol were evaluated for effectiveness in plutonium removal. (R.V.J.)

43334 DECREASE OF THE IRRADIATION DOSE AND ORGANIZATION OF WORK OF THE PERSONNEL OF RADIOLOGICAL DEPARTMENTS. Bogoudinov, R. D.; Korenkov, I. P. Med. Radiol., 13: No. 3, 74-9(1968). (In Russian).

Problems relevant to the reduction of irradiation doses in medical personnel by introducing a number of organizational-technical measures are discussed. The introduction of these measures leads to a reduction of the active time among the auxiliary personnel in radiomanipulation: nurses by 50 to 60%, in assistants by 20 to 25%, in duty nurses by 38%, in the auxiliary personnel by 34%. The referred to investigation led to substantiation of the mean calculation time for technical conditions of protection. (auth)

43335 DEVELOPING NUCLEAR LAW. Int. At. Energy Agency Bull., 10: No. 3, 3-8(1968).

Nuclear law was defined as the law related to the peaceful uses of nuclear science and technology. The roles played by the IAEA and other international organizations in securing compatibility of legislation are briefly summarized. Important aspects of nuclear law and the present status of such laws are succinctly discussed. Nuclear laws for countries that need nuclear legislation are proposed. (B.S.L.)

43336 TRAINING THE ATOMIC LAWYERS. Int. At. Energy Agency Bull., 10: No 3, 9-10(1968).

The first fully international training course as organized by IAEA to study the legal aspects of peaceful uses of atomic energy is briefly described. The course was designed to assist administrators and lawyers who are associated with or may be called upon to assist national authorities in the drafting or implementation of nuclear legislation. The first part of the course was devoted to three main subjects: basic legislation establishing national bodies on atomic energy; international conventions and national legislation on third party liability in the nuclear field; and financial protection against nuclear risks and nuclear insurance problems. The second part of the course focused on: structure and activities of regional and world-wide organizations in the nuclear field; technical and legal aspects of IAEA safeguards and safety standards; licensing of nuclear reactors; and prospects of food irradiation and nuclear power. (B.S.L.)

43337 PROTECTION OF MILK SUPPLIES FROM NUCLEAR CONTAMINATION. **Ward, Gerald M.** (Colorado State Univ., Fort Collins); **Hansen, Warren G.** Colo. Agr. Exp. Sta., Tech. Bull., No. 96, 19p(June 1967).

Information on protective measures that could be applied in the event of peacetime nuclear contamination of a milk supply is presented. The measures suggested were selected on the basis of their effectiveness and feasibility, and were intended for the guidance of those responsible for implementing protective measures: local and state health department staff, county agricultural agents, dairy plant operators, milk producer cooperatives, and individual dairy farmers. The main characteristics were noted for radionuclides which were particularly significant as milk contaminants. With regard to fallout and the milk supply, ^{131}I was of primary concern from a health standpoint during the several-week period immediately after a contaminating nuclear event. Milk was normally the only food product involved in the transport of ^{131}I from fallout to the human body. Grains commonly fed to dairy cattle contained much less radioactivity than forage under typical fallout conditions. Normal storage would generally have resulted in decay of ^{131}I before feeding. Strontium-90 did not move readily from deposition sites in the leaves to the seeds, while ^{137}Cs appeared to be dependent on heavy fallout at the time seeds were forming. If protective action was indicated during the pasture season, cows supplying milk to the fluid milk market could be removed from pasture for a period up to several weeks until the levels of contamination had dropped. The greater the yield of forage per acre, the lower the fission product content per pound of feed. If fertilizer and land management practices were not already optimal, general up-grading was a desirable practice for reducing the intake of fission products by the cows. In the event that removal of animals from pasture was impractical because contamination occurred in a season of the year when stored feed was not available or for some other reason, it would be necessary to divert milk from a "hot spot" area to uses other than human consumption. (BBB)

43338 RADIATION DOSES DELIVERED TO THE SKIN, BONE MARROW, AND GONADS OF PATIENTS DURING CARDIAC CATHETERISATION AND ANGIOCARDIOGRAPHY. **Gough, J. H.** (Brompton Hospital, London); **Davis, R.; Stacey, A. J.** Brit. J. Radiol., 41: 508-18(July 1968).

The radiation doses received by the bone marrow, gonads, and skin of patients during cardiac catheterization and angiocardiography were estimated. During cardiac catheterization the fluoroscopic image was viewed on television monitors associated with image intensifiers, and this was followed by angiocardiography using either cinefluorography or biplane rapid serial radiography, or both, up to three injections of contrast media being given. Procedures used for the dose estimations are described and data on each patient are presented. It was concluded that the diagnostic value of the examinations justifies the relatively high radiation doses received by the patients. (C.H.)

43339 RADIATION EXPOSURE. **Richards, Albert G.** (Univ. of Michigan, Ann Arbor). J. Amer. Dent. Ass., 76: 237(Feb. 1968).

The extent of exposure of dentists to stray radiation and of patient exposure during standard radiographic techniques is examined. When a dental x-ray machine is operated at 65 KVp, 10 ma, and total filtration equivalent to 2.25 mm Al, with a 2.75-in. dia beam measured at the tip of the short pointed cone (7-in. target-skin distance), the dentist could theoretically receive 1400, 2100, and 3000 sec of exposure per week provided he stood 4, 5, and 6 ft, respectively, from the patient. In this way he would not be exposing himself to more radiation than the maximum permissible exposure of 0.1 R/week. Such a typical dental x-ray machine would produce an exposure rate of about 0.77 R/sec at a distance of 8 in. from the target. The total time the machine generates x radiation while exposing the 16 films that compose the complete periapical and posterior interproximal examinations is 3.9 sec. The total exposure of the patient's head is 3.9 sec × 0.77 R/sec, or 3.0 R. Experimental evidence indicates that the gonadal exposure of the adult male from dental x-ray examinations is $\sim {}^{1}/_{10,000}$ that of his head. The female gonadal exposure is less. (BBB)

43340 IN-SAFE THREADING AND STERILIZATION OF RADIUM NEEDLES. Pantoja, Enrique; (Jewish Hospital, Brooklyn. Downstate Medical Center, Brooklyn); Holodny, Edward I. Radiology, 91: 390-1(Aug. 1968).

A water-tight lead box was designed for the safe threading, cold solution sterilization, and storage of radium needles. The box can be transported when mounted on a table with wheels. (C.H.)

43341 ESTIMATION OF THE INTEGRAL DOSE IN STATIC (LOCAL) X AND γ IRRADIATION OF PATIENTS. Yurtaev, B. P. (Scientific-Research Inst. of Roentgenology and Medical Radiology, Tbilisi, USSR). Med. Radiol., 13: No. 2, 30-42(1968). (In Russian).

A procedure for estimating the total integral dose for the whole body and its individual parts in static roentgen- and gamma-radiation is presented. It is based on Meinord's formula, corrected by S. N. Ardashnikov and N. S. Chetverikov, as well as on that of R. G. Mamin and R. Kh. Tenishev. The tables list the values of integral doses from the primary radiation, secondary one, as well as of total doses (in gm-rads), with the surface irradiation dose equalling 100 R, depending upon the irradiation-field area, the skin-focus distance and the body thickness—d(15 – 40 cm) for the x-ray sources of 150, 180, 200 kV and ^{60}Co. Examples of estimating integral doses are offered. (auth)

43342 CONTAMINATION OF THE AIR WITH DECAY PRODUCTS OF RADON IN DWELLINGS IN A REGION WITH AN ELEVATED NATURAL RADIOACTIVITY BACKGROUND. Mikhaylov, M. G.; Yotov, M.; Petkov, T.; Yanachkova, M. (Scientific Research Inst. of Radiology and Radiation Hygiene, Sofia). Rentgenol. Radiol., 6: 112-20(1967). (In Bulgarian).

The distribution of radioactivity and of the decay products of radon in dwellings in the village Bachkovo, Plovdiv District, was studied. This village is located in an area in which the natural radioactive background has a level of 30–50 γ r/hr. The radioactivity in dwellings was highest in the cellar and lowest on the top (second) floor, decreasing still further outside of the buildings (in the court). The average concentration of radioactive substances in the air of the cellars was 16.42×10^{-12} c/l and in the air of the courts 1.73×10^{-12} c/l. The radioactivity in buildings could be ascribed in part to the concentration of radioactive substances in gneiss used as a building material, which had a β-activity of 6.86×10^{-8} c/kg. The importance of investigations of this type from the standpoint of determining contamination due to nuclear explosions is pointed out. (JPRS)

43343 EFFECTS OF METAL IMPLANTS ON TISSUE HEATING IN DECIMETER WAVE IRRADIATION. Rusch, D.; Ott, V. R. (Justus Liebig-Univ., Giessen, Ger.). Arch. Phys. Ther., 18: 353-8(July-Aug. 1966). (In German).

Effects of high frequency diathermy with decimeter waves ($\lambda = 69$ cm) on a fat-muscle-metal phantom designed to measure temperature increases caused by heat absorption by incorporated metals are reported. The phantom was a plastic cube 20 cm along each edge. The fat layer was proximal to the plane of irradiation, and consisted of a 2.25-cm thick layer of pork fat. In place of muscle, a starch paste-NaCl mixture was used. Temperature differences were measured with quartz-benzene thermometers arranged 5 mm apart in the direction of irradiation. Foils made of Sn or Al were placed perpendicular to the direction of irradiation at various depths. Irradiations were carried on for 3 min at 200 W from a distance of 10 cm. There was no significant heating effect in the fat layer. The temperature of the metal foils increased from 1.5 to 2.5 times as much as did the muscle layer. Results indicated that the surface of the patient's body should be perpendicularly oriented toward the radiation source if metal objects are present internally and if a 4-cm layer of muscle is not located between the metal and the radiation source. (BBB)

43344 RADIATION DOSE ABSORBED IN EMBRYO OF DRY RICE SEED. Yamaguchi, Hikoyuki (Tokyo Univ.). Radioisotopes (Tokyo), 17: 395-7(Aug. 1968).

Theoretical evaluations of the absorbed doses at the embryo in dry rice seeds subjected to γ and x rays or thermal neutrons were made. The mass energy-absorption coefficients were determined using the energy of the radiation and chemical composition of the rice seed. Results are presented in tabular form. (B.S.L.)

43345 RADIOACTIVITY IN THE ENVIRONMENT: SOURCES OF RADIOACTIVITY IN THE ENVIRONMENT. Eisenbud, Merril (New York Univ., N. Y.). Pediatrics, 41: Suppl., 174-95(Jan. 1968).

Th nature and effects of natural and artificial radioactivity on man are reviewed. The natural sources of ionizing radiation are considered in terms of those of cosmic and terrestrial origin. The dose man receives from cosmic rays at sea level is about 50 mR/yr, which is slightly less than half the dose received from all natural sources. The effect of altitude is shown. Also examined are the terrestrial sources of natural radioactivity, that is the radioactive elements in the earth's crust that emit penetrating radiation. An individual receives about 50 mrem/yr from this source. About 25 mrem/yr is due to ^{40}K and the daughter products of U and Th that are assimilated from food, water, or air. Manmade radionuclides in the environment are enumerated and the fission products that are of principal biological significance are tabulated. The manner in which the various radionuclides are produced, how they enter the environment, and how they are assimilated into the body are considered. The fallout dose commitments, calculated as world averages, from all nuclear explosions through 1962 are listed. The biological significance of ^{131}I, ^{90}Sr, ^{89}Sr, and ^{137}Cs is examined, as well as future prospects of radiocontamination of the biosphere from peaceful uses of atomic energy. (BBB)

Medicine

Refer also to abstracts 42949, 43045, 43046, 43077, 43206, 43215, 43218, 43254, 43265, 43270, 43285, 43338, 43340, 43341, 43381, 43398, 43405, 43425, 43426, 43437, 43443, 43457–43459, 43460, 43465, 43472, 43478, 43479, and 43492.

43346 (ACRH-28) SEMIANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION. Gottschalk, Alexander (ed.) (Argonne Cancer Research Hospital, Chicago, Ill.). Sept. 1967. Contract AT(11-1)-69. 127p. Dep. CFSTI.

Separate abstracts were written for five of the 15 papers in the report. A list of publications for the research year is given. (B.S.L.)

For abstracts of individual papers see: 43199, 43347, and 43389–43391.

43347 (ACRH-28, pp 111-25) MAGNETIC AND THRESHOLD TECHNIQUES FOR ENERGY CALIBRATION OF HIGH-ENERGY RADIATIONS. Lanzl, L. H. (Argonne Cancer Research Hospital, Chicago).

Most of the accelerators presently used for external-beam radiation therapy are of two types, the betatron and the traveling-wave linear accelerator. Other types in medical use are the cyclotron and synchrocyclotron for neutron and heavy-charged-particle therapy, and the synchrotron for x-ray therapy. The energy calibration problems of electron and x-ray beams from traveling-wave linear accelerators and betatrons are discussed. The betatron and linear accelerator use entirely different electron beam dynamics for the acceleration process. These differences in turn result in dissimilar intrinsic spectra of the accelerated electrons. (auth)

43348 (AD-666822) AN ESTIMATION OF THE PERSONNEL HAZARDS FROM A MULTI-TON BLAST IN A CONIFEROUS FOREST. Final Report. Fletcher, E. R.; Richmond, D. R.; Bowen, I. G.; WHITE: C. S. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Nov. 1967. Contract DA-49-146-XZ-485. 51p. (DASA-2020). CFSTI.

Experiments are described that took place in a managed coniferous forest at various distances from a 50-ton TNT surface burst. The secondary blast hazard to personnel was estimated as a function of range and type of exposure. The tertiary blast hazards were estimated using the measured blast wave parameters and a mathematical model of translation. Six anthropomorphic dummies were placed in the forest to obtain total displacements and partially verify the translation model. The primary blast hazard was estimated from the measured blast wave parameters and earlier studies involving several mammalian species. Measured steel-sphere velocities were used to verify the translational model and to estimate the positive dynamic-pressure impulses at three ranges in the forest and in the cleared sector. (auth) (TAB) (USGRDR)

43349 (UCSF-10-P-2-39, pp 125-260) SOMATIC EFFECTS OF RADIATION. (California Univ., San Francisco. Lab. of Radiobiology).

Eight papers are presented in this section discussing different aspects of the somatic effect of ionizing radiation. The topics discussed include: a tritium tracer study of the effects of increasing cell mass on the growth rate of Ehrlich ascites tumor cells. It was found that the growth rate decreased as the mass increased, and that this trend could be reversed by transfer of cells from an older tumor into a new host indicating a retention of proliferative potential in the older cells; the use of in vivo pulse labeled (^{3}H) and in vitro pulse labeled (^{14}C) bone marrow cells from dogs and man to measure the synthesis(s) phase of growing cell populations; a tracer study of the transit time for granulocytes from bone marrow to blood in dogs. The time was determined to be 102 ± 13.8 hrs; an investigation of the cytokinetic basis of radiation injury and lethality. Evidence supports the fact that a number of, as yet, poorly defined variables contribute to the differential radiosensitivity of mammalian cells; an investigation of the effects of dose fractionation, as used in radiotherapy, in hypoxic cells on recovery of the cells from x irradiation. Studies in mice indicated that fractionation of the x-ray dose reduces the degree of protection of hypoxic cells to the extent that they recover less well than euoxic cells; a study of qualitative alterations in radiation injury under hypoxic conditions. This is an extension of the finding of the previous paper confirming the advantage of fractionated radiotherapy in the selective destruction of hypoxic cells through the reduction of the recovery rate of hypoxic as opposed to euoxic cells; the apparent absence of recovery in endogenous colony-forming cells after irradiation under hypoxic conditions. The use of the endogenous colony-forming ability of spleen cells from whole-body x-irradiated mice allowed for a comparison of the effects of fractionated radiation on hypoxic cells in vivo and in vitro; and the suppression of cellular proliferation in weanling rat kidneys by short-term fasting. In this last paper, it was determined that the renal work load may be the major factor stimulating cellular proliferation in the kidney rather than variations in renal mass. (E.R.B.)

43350 USE OF EPSILON-AMINO-CAPROIC ACID IN EXPERIMENTAL ANIMALS IN THE COURSE OF ACUTE RADIA-

TION SICKNESS. Pospisil, Jan; Skala, Evzen; Beran, Milan; Dienstbier, Zdenek (Univ., Prague. Central Military Hospital, Prague. Veterinary Research Centre, Prague). Strahlentherapie, 135: 346-53(1968).

The effect of epsilon-amino-caproic acid upon the post-irradiation disturbance of hemocoagulation and several further questions of pharmacology of this compound on irradiated animals were studied. Acute toxicity of a certain preparation of EACA was estimated by means of the determination of LD_{50} in mice after ip application of 6.0 g (3.17 to 6.96), after peroral administration of 20 g/kG (18.8 to 21.20) and in rats after ip administration of 6.4 g/kG (6.08 to 6.72). It was found that the acute toxicity of this preparation was unchanged in mice whole-body irradiated by a dose of 500 and 700 R. EACA administered in a dose of 200 mg/kG before irradiation had no radioprotective effect. The administration of EACA in a dose 0.4 g/kG pro die after irradiation of mice within the time period of 29 days did not affect the death rate of experimental animals. EACA administered to rats in a dose of 0.4 g/kG pro die caused leukocytosis and in rats whole-body irradiated with 600 R did not affect the post-irradiation changes in peripheral blood. EACA administered in a dose of 0.4 g/kG pro die to whole-body irradiated dogs (600 R) normalized partially the post-irradiation disturbance of hemocoagulation. In experiments in vitro with the dog blood it was found that EACA partially normalized the hemocoagulation changes caused by heparin and histamine and partially normalized the hemocoagulation changes in the blood of irradiated dogs. (auth)

43351 AN EXPERIMENTAL UNIT FOR FAST NEUTRON RADIOTHERAPY. Greene, David; Thomas, R. L. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Brit. J. Radiol., 41: 455-63(June 1968).

The possible application of 14 MeV neutrons produced by the deuterium–tritium reaction to radiotherapy is discussed. The basic neutron generator is a sealed tube device developed by the Services Electronic Research Laboratory and this is described, as is also an associated shielding and collimating system. It is shown that the neutron beams produced by this device are adequately defined for radiotherapy. The dose-rate at the end of the collimator is equivalent to about 5 RADs/minute of x rays. Percentage depth doses for a limited range of field sizes have been measured at 50, 75, and 100 cm SSD, and the values are intermediate between these for 250 kVp x rays and ^{60}Co γ rays. It is shown that there is a slight buildup effect at the surface, extending to a depth of 2 mm. (auth)

43352 PREPARATION AND BIOLOGICAL BEHAVIOUR OF RADIOGOLD COLLOIDS STABILIZED WITH POLYVINYLPYRROLIDONE (PVP). Caro, R. A. (Univ., Buenos Aires); Nicolini, J. O.; Radicella, R. Int. J. Appl. Radiat. Isotop., 19: 547-50(June 1968).

In the course of comparative studies on the biological properties of colloids, it was necessary to prepare a radiogold (^{198}Au) colloid with a stabilizer other than the commonly used gelatin. Polyvinylpyrrolidone (PVP), which is known to be biologically innocuous, was used as the protective colloid. The preparation procedure was the germ growing method with ascorbic acid as the reducing agent. Two types of homogeneous radiogold sols were prepared, one with mean particle size between 3 and 6 mμ and the other with sizes between 20 and 30 mμ. Physicochemical properties and distribution and elimination in mice were studied. Corresponding biological tests with gelatin protected radiogold colloids of similar particle sizes were also made. A similar distribution was found when the two colloids were injected intravenously; however, when they were injected into the aponeurotic cavity of the rear paw, the activity found in the liver was higher in the case of the gelatin protected dispersions. (UK)

43353 STUDIES OF SOME BIOLOGICAL RADIOPROTECTIVES. 84 REPORT: ON THE QUESTION OF THE SUSCEPTIBILITY OF RADIATION DAMAGE IN SPECIFIC ANTIBODY-PRODUCING SYSTEMS TO RADIOPROTECTIVE SUBSTANCES. Allert, Utz (Univ., Freiburg i. B.). Strahlentherapie, 135: 227-33(1968). (In German).

The effect of radioprotective substances was tested in white mice, using agglutinin production against sheep erythrocytes in irradiated and non-irradiated animals as a criterion. It was observed that a protection of the antibody-producing system prior to the influence of ionizing radiation was obtained neither with serotonin, nor with the estrogen TACE, but it could be obtained with cysteamine. (auth)

43354 OBSERVATIONS ON RADIATION TREATMENT OF MEDULLARY BLASTOMA. Valdagni, C.; Calzavara, F.; Rossetto, S.; Voltolini, A. Radiaz. Alta Energ., 7: 3-16(Jan. 1968). (In Italian).

Diagnosis, pathology, and symptomatology of the disease are discussed briefly and techniques of radiotherapy used at the Tumor Center of Borgo Valsugana are described. The necessity of irradiating the entire cerebrospinal axis is emphasized. The advantages of using two methods of irradiation, ^{60}Co and x radiation are pointed out. An apparatus for screening and containment is described. The dosimetry of the combined radiation fields is estimated. Clinical evidence indicated that this technique produced good results. (H.L.W.)

43355 RESEARCH AND CLINICAL USES OF WHOLE-BODY COUNTERS. Leitnaker, Frank C. Med. Bull. U. S. Army, Eur., 24: 341-5(Sept. 1967).

The whole-body counter differed from other types of instruments in its much greater sensitivity that was partially achieved by shielding around the detector and the source of radioactivity. Detectors used in whole-body counters were liquids, plastic blocks, and NaI crystal. The plastic scintillators and the liquid scintillators possessed the common feature of having an organic scintillator dissolved in a transport solvent. The advantage of the NaI crystal was its greater resolution. The liquid and plastic scintillators, because of their lesser density, showed no maximum absorption peak in their spectra, but only a rather broad, ill-defined maximum. Another form of surveillance consisted of periodic counting of people who had occupational contact with γ-emitting radioactive materials. The third major use of whole-body counters involved the deliberate administration of some radioactive material. Objectives of such studies were to determine the possible retention of an administered radiopharmaceutical in order to assess the radiation dosage that would be received by the body or various parts of the body, to determine abnormal loss of material from the body, and to follow ^{59}Fe- or ^{51}Cr-labeled red cells to demonstrate gastrointestinal bleeding. Similarly, one could quantitate turnover studies. All diagnostic radiation exposures should be kept as low as possible in a patient who was free of disease. (BBB)

43356 PROCEEDINGS OF THE 19TH ANNUAL CONFERENCE ON ENGINEERING IN MEDICINE AND BIOLOGY, SAN FRANCISCO, CALIFORNIA, NOVEMBER 14–17, 1966. VOLUME 8. Vurek, Gerald G. (ed.). New York, Institute of Electrical and Electronics Engineers and Pittsburgh, Instrument Society of America, 1966. 287p. $15.00 Softbound; $18.00 Hardbound. (CONF-661119). DTIE.

A total of 249 papers was presented at the conference. Six papers are listed separately for Nuclear Science Abstracts. (B.S.L.)

For title listings of individual papers see: 43172, 43221, 43275, 43357, 43358, and 43409.

43357 ONE DIMENSIONAL BACTERIAL COLONY COUNTING BASED UPON THE SCATTERING OF A LASER BEAM. Bowman, Robert L.; Blume, Philip (National Heart Inst., Bethesda, Md.). pp 57 of Proceedings of the 19th Annual Conference on Engineering in Medicine and Biology, San Francisco, California, November 14–17, 1966. Volume 8. Vurek, Gerald G. (ed.). New York, Institute of Electrical and Electronics Engineers and Pittsburgh, Instrument Society of America, 1966.

See CONF-661119.

43358 SOME ENGINEERING PROBLEMS IN THE USE OF A HIGH ENERGY NEODYMIUM LASER ON MALIGNANT TUMORS. Riggle, Grant C.; Hoye, Robert C. (National Institutes of Health, Bethesda, Md.). pp 58 of Proceedings of the 19th Annual Conference on Engineering in Medicine and Biology, San Francisco, California, November 14–17, 1966. Volume 8. Vurek, Gerald G. (ed.). New York, Institute of Electrical and Electronics Engineers and Pittsburgh, Instrument Society of America, 1966.

See CONF-661119.

43359 RADIATION BIOLOGICAL CONTRIBUTIONS TO RADIATION THERAPY. Powers, W. E. (Washington Univ., St. Louis). pp 405-32 of Canadian Cancer Conference. Vol. 7. Morgan, J. F. (ed.). New York, Pergamon Press, 1967.

From 7th Canadian Cancer Research Conference, Honey Harbour, Ontario, Canada, June 1966. See CONF-660658.

Observations on tumor growth, anoxic cell populations within a tumor, and preoperative radiation are presented with implications for radiotherapy. Preclinical and clinically detectable growth of either transplanted or spontaneous tumors in animals demonstrates a growth rate that becomes progressively slower with increased age and size of the tumor. Preclinical experience with animal tumors substantiates proposals that administration of hyperbaric oxygen during radiotherapy will improve cure rates or reduce required doses. Preoperative radiation therapy offers unique advantages as a possible method for improvement of tumor therapy. (M.M.B.)

43360 AGEING STUDIES IN A MARSHALLESE POPULATION EXPOSED TO RADIOACTIVE FALLOUT IN 1954. Conard, Robert A.; Lowrey, Austin; Eicher, Maynard; Thompson, Keith; Scott, William A. (Brookhaven National Lab., Upton, N. Y.). pp 345-60 of Radiation and Ageing. Lindop, Patricia J. (ed.). London, Taylor and Francis Ltd., 1966.

From International Colloquium on Radiations and Ageing, Semmering, Austria, June 23–24, 1966. See CONF-660635.

Late effects of radiation in a Marshall Island population accidentally exposed to radioactive fallout in 1954 are reviewed. The most significant findings were in regard to the development of thyroid abnormalities that occurred largely in children exposed at less than 10 years of age, and presumably caused by irradiation of the thyroid gland from internal absorption of radioiodines in the fallout and γ radiation. Possible radiation induced ageing effects were studied in 90 adults, 36 exposed and 55 unexposed by measurement of 14 criteria usually associated with ageing. Analysis of variance was used to determine correlation with age and the data for each criterion were weighted according to this correlation factor. Combined scores for all criteria gave a measure of physiological age as compared with chronological age on an individual and group basis. Most of the criteria showed good correlation with age on a group basis, less so on an individual basis. Between 20 and 40 years of age the criteria showed less change than after that age. No significant differences were noted between the exposed and unexposed groups. It was postulated that if there were ageing effects from the dose of radiation received by this population more sensitive tests would be necessary to show them. Longitudinal studies of individuals and groups in this Marshallese population might be more rewarding in the future. (auth)

43361 PREIRRADIATION ACID-SOLUBLE SULFHYDRYL LEVEL-CHANGES IN THE CULTURES OF ESCHERICHIA COLI STRAIN $15T^-$ IN THE PRESENCE OF CYSTEINE. Nagy, Zs.; Kovacs, P.; Balazs, Cs.; Hernadi, F. (Univ. Medical School, Debrecen, Hungary). Biochem. Pharmacol., 17: 861-6(June 1968).

The addition of L-cysteine-HCl to growing cultures of *E. coli* $15T^-$ log, phase cells, resulted in a decrease of their sensitivity to x radiation, even when cysteine was removed from the cell-suspensions prior to irradiation. Cysteine proved to be effective as a radiosensitivity-modifying agent at concentrations of 1 to 10 mM. Simultaneously cysteine increased the cellular AS-SH level of the bacteria. This rise was found to depend on the doses of cysteine and the length of the incubation period. Extracellular cysteine at concentrations of 0.05 mM and upwards caused a detectable SH surplus intracellularly, that increased up to 5 mM. Higher concentrations of cysteine failed to induce a further rise of the bacterial SH content. At a given concentration the AS-SH level increasing effect of cysteine set in 30 sec after adding it to the cultures, the maximum level being reached around the 15th min. No direct correlation existed between the changes in the radiosensitivity of the cells and their enhanced endogenous SH level. (auth)

43362 RADIOTHERAPEUTIC MANAGEMENT OF NEUROBLASTOMA IN CHILDHOOD. Tefft, M.; Wittenborg, M. H. J. Amer. Med. Ass., 205: 159-60(July 15, 1968).

The occurrence of neuroblastoma of childhood and its occasional spontaneous remission is briefly reviewed; conclusions regarding the effectiveness of the therapeutic agent or agents (drugs, surgery, and radiotherapy) being used are included. Prevention of radiation injuries during therapy for resectable and nonresectable tumors through shielding is discussed. Methods for protection of kidneys, ovaries, spinal cord, vertebrae, and the visceral organs during therapy are succinctly outlined. Mortality rates are discussed. (E.R.B.)

43363 ASCORBIC ACID EFFECTS ON RADIORESISTANCE OF COTTON. Nazirov, N. N.; Arslanova, S. (Inst. of Botany, Tashkent). Dokl. Akad. Nauk Uzb. SSR, No. 11, 52-4(1967). (In Russian).

Experimental data obtained on ascorbic acid effects on radioresistance of cotton seed γ-irradiated at 10 kR doses showed that 24 hr soaking of cotton seeds in 0.01 M ascorbic acid solution increased resistance. (R.V.J.)

43364 SOME TECHNICAL ASPECTS OF THE APPLICATION OF REACTOR RADIATION AND RADIOISOTOPES IN NUCLEAR MEDICINE. Zamparo, Giuseppe (Univ., Genoa). Ing. Nucl., 9: 33-47(Jan.-Feb. 1968). (In Italian).

The use of neutron, gamma, and particle radiations from reactors to determine radiation effects on biological materials and systems is reviewed; diagrams of irradiation facilities of several research reactors are included. Neutron capture therapy and dosimetry are discussed. Data on reactor produced radioisotopes used in medical diagnosis and therapy, biological research, agriculture, technological research, and industry are presented and discussed. (25 references). (B.S.L.)

43365 CLINICAL INDICATIONS AND LIMITATIONS IN APPLICATION OF WEDGE FILTERS IN FIXED FIELD TELECOBALT THERAPY. Sosso, A. (Univ., Turin). Minerva Radiol., 13: 48-64(Jan.-Feb. 1968). (In Italian).

Various modes of using wedge filters in fixed field cobalt therapy are reviewed: two converging filtered bands, two converging filtered bands with a non-filtered band interposed, a single band or two filtered wedge-shaped bands with one or two non-filtered bands. The use of filtered bands is indicated for circumscribed superficial tumors generally underlying curved skin surfaces. The distribution of doses obtained with two converging filtered wedge-shaped bands is examined and the advantages and clinical limitations are discussed. The method gives a rapid fall in the peripheral dose. Complementary indications are next considered. The possibility of employing wedge-shaped filters in tumors of the thorax, in irradiation of the thoracic wall after mastectomy, and in renal, rectal, and vesical tumors is examined. Emphasis is placed on the usefulness of this technique in telecobalt therapy. (H.L.W.)

43366 EFFECTS OF PHARMACOLOGICAL AND SURGICAL EXCLUSION OF DIFFERENT DIVISIONS OF THE NERVOUS SYSTEM ON THE ACTIVITY OF RADIOPROTECTIVE AGENTS. Strelkov, R. B.; Parasochko, L. A.; Reshetnyak, V. I. (Inst. of Experimental Pathology and Therapy, Sukhumi, USSR). Farmakol. Toksikol., No. 5, 571-6(Sept. 1966). (In Russian).

The role of cortical inhibition in the mechanism of the radioprotective action of sodium amytal and the effect of anesthesia on the radioprotective agents metheneamine and mexamine [5-methoxytryptamine] in mice exposed to almost lethal doses of gamma radiation is described. Sodium amytal had only a slight radioprotective effect, but when combined with metheneamine and mexamine, it had no influence on the radioprotective action of the latter two agents. Removal of the cortex and subjacent subcortex had no effect on the severity or outcome of radiation sickness or on the potency of the radioprotective agents. However, transection of the spinal cord and sympathetic trunks sharply reduced the activity of mexamine but not that of metheneamine when the animal was irradiated below the site of the transection. Preliminary injection of the mice with the central cholinolytic metamizil, central sympatholytic chlorpromazine, or ganglion-blocking agent hexamethonium did not impair the radioprotective action of metheneamine after irradiation. The radioprotective action of mexamine was markedly reduced by preliminary injection of chloropromazine, but not by injection of metamizil or hexamethonium. (JPRS)

43367 TOPICAL CHEMICAL PROTECTION AGAINST ORAL RADIATION DEATH IN MICE. Goepp, Robert A.; Fitch, Frank W. (Univ. of Chicago). Radiat. Res., 34: 36-48(1968).

The effect of topical application of protective chemicals on the mortality and histopathologic changes of oral radiation death in mice was studied. The chemicals mercaptoethylamine (MEA), aminoethylisothiuronium (AET), and p-aminopropiophenone (PAPP) were applied to the dorsal surface of the tongue in C57Bl male mice. Preirradiation treatment with MEA produced a calculated dose-reduction factor of 1.35, and AET produced a calculated dose-reduction factor of 1.29. Repeated trials with PAPP failed to produce any detectable protection. The postirradiation histologic changes in the tongues of protected mice were the same as those seen in irradiated control mice except that the changes were far less severe and the protected tongues recovered one week after irradiation, while the irradiated controls exhibited ulceration on the ninth postirradiation day. The histologic evidence suggested that there was appreciable protection by two of the chemicals, MEA and AET, and further that the DRF values, which are based on mortality, do not fully indicate the degree of chemical protection because it was apparently impossible to consistently apply the chemicals to the posterior area of the tongue, the area most critically sensitive to irradiation. (auth)

43368 CHANGES IN THE CANCER RISK ASSOCIATED WITH OBSTETRIC RADIOGRAPHY. Stewart, Alice; Kneale, G. W. (Oxford Univ.). Lancet, 1: 104-7(Jan. 20, 1968).

The prenatal experiences of 12,694 children who were born between 1943 and 1965 were the subject of an inquiry, the purpose of which was to discover how the cancer hazard associated with obstetric radiography varied over the years 1946 to 1962. Half of the children had died from a malignant disease before the age of ten years during the period 1953-65 and the other half were alive and well when the data were collected. The controls were individually matched for sex, date of birth, and region with the cases. The case group contained 985 children who were x-rayed in utero, and in the control group 645, and it is suggested that about 370, or

6%, of the traced cases were caused by these examinations. If it had been possible to include in the survey all the children who were born in England, Scotland, and Wales between 1946 and 1962 and subsequently died from cancers before the age of ten years, it is estimated that there would have been in the region of 10,500 non-radiogenic and 650 radiogenic cases (i.e., 94.5% and 5.5%, respectively). In this country, juvenile cancer deaths affect about one in every 1200 liveborn children or 620 members of each birth cohort. At the beginning of the study period children who were x rayed in utero were over twice as likely to encounter such a death as their non-x rayed contemporaries, and at the end of the period 1.4 times as likely; but the risk of being x rayed was lowest at the beginning of the period and higher in the middle than at the end. Compared with the immediately preceding and following years, the period 1955-57 was a hazardous one in which to be x rayed, and the period 1960-62 compared unfavorably with the period 1958-59. Temporary interruptions in the trend towards safer obstetric radiography are ascribed partly to changes in x ray procedures and partly to premature rebuttal of the cancer hazard. The available evidence suggests that small doses of x rays are sufficient to initiate cancer processes in immature tissues, and that all such tissues are equally radiosensitive. It is not, however, possible to say whether this effect is confined to immature tissues since it is possible that the timing of obstetric x rays in relation to the children concerned (and the whole body exposures) were only of importance in revealing a wider hazard. (auth)

43369 X RAYS AND CHILDHOOD CANCER. Lancet, 1: 577(Mar. 16, 1968).

A review is presented of the literature concerning records of exposure of pregnant women to diagnostic x rays and the relationship of these records to deaths from cancer among the offspring. It was concluded that x rays may cause an excess risk in the development of cancer in the offspring of mothers exposed during pregnancy. (H.L.W.)

43370 RADIATION DOSE IN ISOTOPE ENCEPHALOGRAPHY. Bull, James (National Hospital, London). Lancet, 1: 357-8 (Feb. 17, 1968).

The calculation of dose resulting from internal administration of ^{131}I is discussed. Methods of estimating the volume of the cerebrospinal fluid are described. The volume of fluid in the following pathological conditions is discussed: communicating hydrocephalus with severe obstruction to cerebrospinal flow; communicating hydrocephalus with partial obstruction to cerebrospinal flow; and cerebral atrophy with free cerebrospinal flow. Methods of diffusion of the isotope from the cerebrospinal fluid to the blood are discussed. (H.L.W.)

43371 RADIATION DOSE IN ISOTOPE ENCEPHALOGRAPHY. Sear, R.; Cohen, M. (London Hospital). Lancet, 1: 249-50 (Feb. 3, 1968).

The calculation of dose resulting from internal administration of ^{131}I is discussed. The risks of injecting radioactive material into the central nervous system are pointed out. It is suggested that the technique of isotope encephalography gives a higher dosage than most other neurological investigations using isotopes. The use of the technique is recommended only for elderly patients in view of the possibility of clinical improvement in an otherwise progressive condition. (H.L.W.)

43372 INVESTIGATIONS ON A BIOLOGICAL RADIATION PROTECTION AGENT. PART 85. ON THE ACTION OF 5-HYDROXYTRYPTOPHAN IN THE CASE OF WHOLE-BODY IRRADIATION OF MICE. Langendorff, Hanns; Langendorff, Margarethe; Streffer, Christian (Univ., Freiburg i.B.). Strahlentherapie, 135: 452-8(Apr. 1968). (In German).

The radioprotective effect of 5-hydroxytryptophan (5-HTP) on survival of whole-body irradiated mice was studied. Doses between 2 and 10 mg of 5-HTP exerted a protective effect proportional to the dose. When administered 20 minutes before the irradiation, the amino acid had a more pronounced effect than when given 60 minutes before. The injection of an inhibitor of 5-HTP-decarboxylase (N-(DL-seryl)-N'-(2,3,4-trihydroxybenzyl)-hydrazine (Ro4-4602)) 60 minutes earlier than 5-HTP neutralized the protective effect of the amino acid. The amount of 5-HTP-decarboxylase in the liver was considerably lowered in these circumstances. A good correlation was found between this enzyme activity and the protection efficiency. (auth)

43373 DOSE DISTRIBUTION IN TIME IN RADIUM THERAPY OF MALIGNANT TUMORS. Balmukhanov, S. B.; Zholkiver, K. I. (Kazakh Scientific-Research Inst. of Oncology and Radiology, Alma-Ata, USSR). Med. Radiol., 13: No. 2, 3-14(1968). (In Russian).

The method of daily fractional irradiation, based in conditions of orthovolt x-ray therapy, was transferred into modern clinical radiology without due critique. This survey article discusses the phenomena occurring in the cells and tissues in single and repeated irradiation, as well as problems of the optimal duration of the interval between individual fractions and dose values in fractional irradiation. The article contains a survey of clinical works on the ratio between the dose and time in radium therapy of malignant tumors. The authors give a theoretical substantiation of methods of median and large dose fractionation, as well as intermittent radium treatment. Large fractionation with a small number of fractions should be used in far-advanced forms of neoplasms; they require wide clinical trial of intermittent irradiation and the method of median dose fractionation. (auth)

43374 DOSE BURDEN FROM TYPICAL FLUOROSCOPIC SKELETAL PHOTOGRAPHS. **Seyss, R. (Krankenhaus, Neunkirchen, Austria). Monatsschr. Unfallheilk., 69: 547-9(1966). (In German).**

Average doses of irradiation from fluoroscopic studies in peripheral areas of the skeleton in 112 patients are reported. The studies represented follow-ups to x ray studies where bone injuries were suspected. The areas studied included 24 in portions of the spinal column, 56 studies of the upper extremities, and 32 studies of the lower extremities. The energy factors used ranged from five to 70 mW-sec at 70 KV, to 19 mW-sec at 90 KV, and to 10 mW-sec at 150 KV. The average energy dose used was 15 mW-sec. In comparison to these values, an average of 9.9 mW-sec was used in 740 lung x ray studies, where the range was from three to 21 mW-sec. In irrigoscopies it was not possible to use less than 200 to 400 mW-sec. It was concluded that bone fluoroscopy was justified because low dose energies could be used to detect fracture lines and fissures, or atypical fractures in patients where conventional x-ray studies did not reveal traumatic changes. Fluoroscopic studies of this type were facilitated and dose energies were minimized by use of image intensifier-television combinations. (BBB)

43375 DETERMINATION OF THE RENAL CIRCULATION DURING RENOGRAPHY WITH THE AID OF RADIOIODINE-LABELLED HIPPURAN. Sysoev, V. F. Med. Radiol., 13: No. 4, 74-8(1968). (In Russian).

Mathematical substantiation and description of the technique of determining renal circulation with the aid of a single injection of radioiodine-labeled hippuran is presented. The procedure was specially devised to combine recording of the radioisotope renogram, however, this investigation alone is also of importance, since the determination of median concentration of radioiodine-labeled hippuran in the blood by the referred to technique is more precise and simple in comparison with methods described earlier. (tr. auth)

43376 INTERSTITIAL IRRADIATION WITH ^{192}Ir IN THE PREVENTION OF RELAPSES AFTER SURGICAL REMOVAL OF CHELOID SCARS. **Nicoletis, C.; Chassagne, D. (Institut Gustave-Roussy, Villejuif, France). Ann. Chir. Plast., Sem. Hop., 12: 237-41(Sept. 19, 1967). (In French).**

A new method was developed for postoperative irradiation of cheloid scars to better prevent the recurrence of this condition. It was considered necessary to confine the dose to within the thickness of the skin treated, to avoid insufficient irradiation of the target area and excessive irradiation of neighboring tissue. The new technique was based on use of nonradioactive implants placed ahead of time in the center of the tissue and the use of ^{192}Ir, available in wire of very small diameter in varying lengths, and introduced into the previously placed tubes. Interstitial irradiation began generally three to four hr after surgical incision. A ^{192}Ir wire 0.3 mm in dia (0.1 mm surrounded by a platinum tube) was adapted to the length of the scar. X-ray radiography permitted verification of placement. Dosimetry was based on the properties of ^{192}Ir: average energy of 300 KeV, half-life of 74 hr, specific irradiation dose rate of 5 R/hr. For a 2.5 mm radius from the center of the wire, the dose was 50 R/hr, or 1200 rad. The advantages of this new method were, first, good protection of both therapist and patient. This was not possible in conventional Ra therapy because of the more energetic γ radiation thus exposing both patient and technician unnecessarily. The second advantage was its adaptability to whatever body region was being treated, because of its thinness and flexibility. Disadvantages were necessity of hospitilization for a period of time; some unnecessary irradiation in the neighboring area; and a tendency to enlargement and discoloration of the scar. (BBB)

43377 CANCER RISK IN OBSTETRIC RADIOGRAPHY. Dunn, Peter M. Lancet, 1: 208(Jan. 27, 1968).

A discussion is presented of literature reports on the risk of cancer in children resulting from obstetric radiography. It is pointed out that the reports are based on the supposition that the incidence of juvenile cancer in the case group and the controls would have been similar but for the exposure of the former during fetal life. This assumption makes no allowance for the maternal and fetal factors leading to the need for obstetric radiography in the case group. Since the use of obstetric radiography is often beneficial, it is thought that the risks are balanced by the advantages gained. (H.L.W.)

43378 PREPARATION AND RADIATION PROTECTIVE PROPERTIES OF SOME DERIVATIVES OF BETA-MERCAPTOPROPIONIC ACID, CYSTAMINE, AND CYSTEAMINE. **Airapetyan, G. M.; Zherebchenko, P. G.; Bystrova, V. M.; Benevolenskaya, Z. V.; Kuleshova, N. D.; Lin'kova, M. G.; Kil'disheva, O. V.; Knunyants, I. L. (Inst. of Elemental-Organic Compounds, Moscow). Izv. Akad. Nauk SSSR, Ser. Khim., No. 2, 334-41 (1967). (In Russian).**

A series of derivatives of β-mercaptopropionic acid, cystamine, and cysteamine were synthesized and their radioprotective effects studied. Reactions and procedures used to obtain the compounds are presented. The toxicity of the synthesized compounds was low with the exception of the amide resulting from reactions of substituted amides of β-chloropropionic acid with thiourea. White mice were intraperitoneally injected with 400 to 500 mg/kg body wt of the synthesized derivatives and 15 min postinjection were irradiated at a dose of 200 R. Cysteamine reacted with carbon disulfide in the presence of NaOH. (TSS)

43379 TELECESIUM TREATMENT OF CARCINOMA OF THE LARYNX AND HYPOPHARYNX. **Kaufmann, H.; Lichtenberger, K. (Staedtische Krankenanstalten, Essen). Ger. Med. Mon., 12: 64-70(Feb. 1967).**

The results and complications of treating 33 cases of laryngeal carcinoma and 14 of hypopharyngeal carcinoma with telecesium irradiation during the last 3 yr are reported. The only skin reaction was mild dry dermatitis which rapidly subsided. The only subjective complaints were mild irritation in the throat. Inspection of the mucosa revealed slight reddening throughout the pharynx but no significant swelling; in no case was there any edema of the glottis. Necrosis of cartilage was not encountered though in one case perichondritis was found on follow up where the very high dose of 220 R every second day was given. The total dose was increased up to 6000 R without causing additional skin damage. For tumors of the larynx and hypopharynx, telecesium irradiation met all the criteria of high voltage therapy for good cure rates, minimal skin damage, and little or no risk of severe mucosal reactions or cartilage necrosis. For the treatment of laryngeal carcinoma, telecesium had advantages over telecobalt; it offered opportunities for giving half-depth therapy; it was easy to handle; and it was relatively economical. (BBB)

43380 EXTERNAL APPLICATORS MADE OF ACRYLIC RESIN FOR CARRYING ^{192}Ir. **Lecacheux, B. (Centre Anticancereux Regional, Caen, France); Robillard, J.; Bloquel, J. Rev. Stomatol. 68: 500-6(1967). (In French).**

Advantages and dose reduction to patients and personnel by the use of ^{192}Ir-bearing external applicators are discussed. In comparison with ^{192}Ir, the high energy of γ radiation of radium (1.40 MeV) causes problems in the protection of tissue surrounding the locally irradiated area. The metal shielding to protect against half the radiation emitted must be 12 mm of lead, and conventional protective shields must be 12 cm thick. At the time of applying Ra the operator is not protected. Placement and size of radiogenic sources are not flexible with Ra. However, the artificial radioactive element ^{192}Ir produces a homogeneous γ radiation field of low energy (0.3 MeV) and is available in flexible wires of 0.3 or 0.5 mm dia which can be cut to a desired length according to the requirements of the area treated. This new element has revived interest in the technique of plesiocurie therapy because of both the greater precision in localization of the irradiation area and the preloading technique. The ^{192}Ir wire is inserted in an outer plastic tube that can be placed in the patient before the radioelement is introduced. This increases protection because doses can be calculated and adjusted accurately before irradiation. Methods of constructing the apparatus and manufacture of the molded acrylic resin applicator are discussed. (BBB)

43381 EFFECT OF VITAMEDIN ON THE RADIATION SICKNESS. **Nishimura, Takeshige (Kyoto Univ.). Jibiinkoka Rinsho, 59: 603-8(June 1966). (In Japanese).**

To 25 cases of malignant tumors of the head and neck treated by radiotherapy, Vitamedin was administered per os with a daily dose of three capsules, and its effect on radiation sickness was studied. In 15 cases (60%) radiation sickness was not observed, showing the effectiveness of Vitamedin; in ten cases its effect was not clearly shown or radiation sickness appeared. It was found that Vitamedin was scarcely effective in the combined radiotherapy and chemotherapy, effective in half the cases of the postoperative irradiation, and considerably effective in the radiotherapy only. Vitamedin was effective not only in radiation sickness and anemia, but also in the postoperative nervous disturbances. No side effects were observed by the administration in the range of doses used. (NSA of Japan)

43382 THE PROBLEM OF TREATMENT OF MALIGNANT TUMORS FROM THE VIEWPOINT OF THE PATHOLOGIST. **Krueckemeyer, R. Forsch.-Praxis-Fortbild., 18: 120-3(1967). (In German).**

Convention x irradiation, treatment with supervoltage electrons, and chemotherapy of malignant tumors all produce similar clinical and morphological effects. The morphological cell changes produced are nonspecific for these kinds of treatment, and show that the tumor is not entirely destroyed. The clinical healing observed and the chance that there may be some life prolongation cannot be reconciled objectively with the histomorphology of the tumor treated. This indicates a discrepancy between a clinical evaluation of success and the morphological substrate that accompanies it. The morphological picture that is observed after radiotherapy and chemotherapy tells nothing about how life expectation may be influenced, because the tumor cells that are still alive and undamaged are able to remain latent for long periods of time, and the newly formed connective tissue and scar tissue does not provide for a direct protection against them. Thus, it is apparent that only timely radical surgery of malignant tumors promises a definite chance of permanent healing. Irradiation therapy is useful only in advanced stages when there is much less chance for successful use of surgery. (BBB)

43383 LASER RADIATION AND THE TUMOR PROBLEM. **Jaenisch, W.; Dietz, W.; Altrock, H.; Osske, G. (Pathologische Institut, Erfurt, Ger.). Deut. Gesundheitsw., 23: 916-21(May 16, 1968). (In German).**

At present, there do not exist any effective methods of treating malignant tumors with laser radiation. The technical development of laser appliances will, however, be followed up very closely with tumor research, for possibly laser radiation in the short-wave range may be useful for tumor therapy because of the increased penetrating ability and new biological effects. So far development of tumors following laser irradiation has not been observed in man or experimental animals. (auth)

43384 CYTOGENETICS OF THE IN-UTERO EXPOSED OF HIROSHIMA AND NAGASAKI. **Bloom, Arthur D.; Neriishi, Shotaro; Archer, Philip G. (Atomic Bomb Casualty Commission, Hiroshima. Atomic Bomb Casualty Commission, Nagasaki). Lancet, 2: No. 7558, 10-12(July 6, 1968).**

Among 38 in-utero-exposed survivors of Hiroshima and Nagasaki whose mothers were exposed to more than 100 rad at the time of the bombings, the frequency of peripheral blood lymphocytes with complex chromosomal rearrangements was 0.52%. Among 48 controls, the frequency was 0.04%, and 39% of the in-utero exposed survivors who had these aberrations, as contrasted to 4% of the controls. These results suggest that both lymphocyte precursors and mature, immunologically competent lymphocytes were affected in utero by the ionizing radiations of the A-bombs. (auth)

43385 IN VIVO AUTORADIOGRAPHY OF ^{133}Xe DISTRIBUTION IN THE CYSTIC HUMAN KIDNEY. **Ter-Pogassian, Michel M.; Koehler, P. Ruben; Potchen, E. James (Washington Univ., St. Louis). Radiology, 91: 358-62(Aug. 1968).**

The kinetics of the intrarenal distribution of ^{133}Xe were investigated, using ciné scintigraphy with a Ter-Pogossian-Picker Magnacamera. In two patients with renal cysts, the cyst diffusion was markedly different from that of normal kidney tissue. Inhomogeneous diffusion will invalidate the multicompartment method for assessment of the intrarenal distribution of blood flow in patients with renal cysts. (auth)

43386 CLINICAL APPLICATION OF BONE SCINTISCANS. **DeNardo, Gerald L. (Stanford School of Medicine, Palo Alto, Calif.). Clin. Med., 75: 22-32(Jan. 1968).**

The use of ^{85}Sr in bone scintigraphy is discussed and reviewed. Clinical indications for ^{85}Sr scanning, equipment required, and the methods used are described. The results from 114 ^{85}Sr scintigrams are described and evaluated. The simplicity, safety, and routine use of the ^{85}Sr scintiscan is emphasized. The use of ^{87m}Sr as a bone scanning agent has an advantage because of its shorter half life, as compared to ^{85}Sr. Other short-lived radioisotopes, such as ^{18}F and ^{68}Ga, are also valuable in bone scanning. (BBB)

43387 CONCENTRATION OF ^{99m}Tc BY THE CHOROID PLEXUS. EXPERIMENTAL DEMONSTRATION IN VIVO. Witcofski, Richard L.; Maynard, C. Douglas; Janeway, Richard (Wake Forest Univ., Winston–Salem, N. C.). Arch. Neurol., 18: 301-3(Mar. 1968).

Uptake of sodium pertechnetate-^{99m}Tc by the choroid plexus in brain scanning may interfere with interpretation. This uptake may be partially blocked with iodide (Lugol's solution) or completely blocked with $KClO_4$. This implies that there is an active concentration process occurring in the choroid plexus. Both active concentration of ^{99m}Tc by the choroid plexus and blocking of this process with $KClO_4$ were confirmed in vivo in rabbits. (BBB)

43388 SEPHADEX FOR ORGAN LOCALIZATION OF BIOLOGICALLY ACTIVE RADIONUCLIDES. Johnson, A. E.; Gollan, F. (Veterans Administration Hospital, Miami, Fla. Univ. of Miami School of Medicine, Fla.). Int. J. Appl. Radiat. Isotop., 19: 550-2(June 1968).

High molecular dextran in the form of Sephadex beads, 10 to 300 μ in diameter, can be used as a carrier for radionuclides and radioactive compounds in aqueous or organic solvents. Depending on their size, these beads are deposited in the liver or in the lungs of rats and the radioactive pharmaceutical is released in high concentration. (UK)

Radiation Effects on Animals

Refer also to abstracts 43202, 43203, 43208, 43209, 43216, 43217, 43224–43226, 43240–43242, 43244, 43250–43253, 43262, 43268, 43277, 43285, 43286, 43295, 43298, 43300, 43305, 43323, 43329, 43330, 43334, 43339, 43341, 43349, 43350, 43353, 43356, 43359, 43360, 43364, 43366–43371, 43373, 43376–43379, 43383, 43384, 43476, 43493–43495, and 43516.

43389 (ACRH-28, pp 14-22) A COMPARISON OF THE RATES AT WHICH COLONY FORMING UNITS AND ERYTHROPOIETIN RESPONSIVE CELLS RECOVER AFTER 200 R TOTAL BODY X IRRADIATION. Weisman, M.; Martensen, D.; Fried, W.; Gurney, C. W. (Argonne Cancer Research Hospital, Chicago).

Experiments designed to compare the rate of recovery of erythropoietin responsive cells (ERC) in polycythemic mice after irradiation at a dose of 200 R and to compare the rate of recovery of colony forming units (CFU) in the leg or tail of similarly irradiated mice are described. Recovery of CFU was measured by an endogenous technique (shielding) to avoid the complications of transplantation. The ability of the polycythemic mice to respond to erythropoietin was reduced to 3 percent of normal immediately following irradiation. Recovery reached 15 percent by 4 days, 56 percent by day 6, 81 percent by day 8, and 100 percent by day 10. Colony forming ability in the leg proceeded in a similar fashion. The colonizing potential of cells in the tail, however, recovered much more slowly. It was concluded that polycythemia did not significantly alter the rate of recovery of ERC or CFU. Factors affecting the rate of colonization by cells in the tail are discussed. (B.S.L.)

43390 (ACRH-28, pp 23-34) ERYTHROID DIFFERENTIATION DURING STEM CELL PROLIFERATION. DeGowin, R. L. (Argonne Cancer Research Hospital, Chicago).

The proliferation and differentiation of hemopoietic stem cells in irradiated mice were studied using tracer techniques. The shielding of femoral marrow from supralethal doses of x-ray permitted the study of erythropoiesis in an isolated population of nonirradiated endogenous stem cells after they migrated to and colonized the spleen. Results indicated that during replication, stem cells in the process of synthesizing DNA were not available for differentiation and appeared to be refractory to the erythropoietic effects of erythropoietin. After replication of the stem cell compartment, the cells became responsive to stimuli for differentiation, and specialized cells appeared in the peripheral blood after their generation in the spleen and marrow. The recovered hematopoietic system was sufficient to save the animal from radiation death due to destruction of the bone marrow. (B.S.L.)

43391 (ACRH-28, pp 101-4) REDUCED INCORPORATION OF ISOTOPE-LABELED COMPOUNDS IN HAIR FOLLOWING IONIZING RADIATION: DOSE RESPONSIVENESS IN ANAGEN AND TELOGEN RODENT HAIRS. Malkinson, F. D.; Griem, M. L. (Argonne Cancer Research Hospital, Chicago).

A technique for demonstrating reduced uptake of isotope labeled compounds in irradiated rodent hair is described. The effects of radiation on anagen and telogen hairs of mice were studied using the technique. Results indicated that the magnitude of reduced incorporation of isotope labeled compounds in hair was dose dependent. Nondividing hair matrix cells (telogen hairs) were susceptible to radiation damage, however, the dose of radiation had to be twice as large as those required to produce comparable injury in anagen hairs. (B.S.L.)

43392 (AD-665664) IMMEDIATE IRRADIATION EFFECT ON RESISTANCE OF RATS TO LOW TEMPERATURE. Phillips, Richard D.; Kimeldorf, Donald J. (Naval Radiological Defense Lab., San Francisco, Calif.). Jan. 4, 1968. 22p. (USNRDL-TR-68-6). CFSTI.

A study was made of the effect of whole-body x irradiation (50–2000 rads) on the resistance of male rats exposed to a low environmental temperature (−17.0 ± 1C). The animals were subjected to the test environment at ½, 4, 8, 16, or 24 hours after irradiation. A change in resistance was observed after irradiation with doses of 100 rads or more. Irradiation had a detrimental effect on the survival of rats exposed to low temperature at all times tested. The radiation-induced decrease in cold resistance was greater in groups tested early after irradiation than in groups tested at 16 or 24 hours postirradiation. The magnitude of the radiation effect was dose dependent. At doses greater than 100 rads, the median survival time of rats in the cold was inversely related to radiation dose. (auth) (USGRDR)

43393 (AFRRI-SR-68-5) MONKEY (MACACA MULATTA) SURVIVAL TIMES AFTER PULSED GAMMA-NEUTRON IRRADIATION. Turbyfill, C. L.; Pitchford, T. L.; Cramer, M. B. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). Apr. 1968. 21p.

Fifty monkeys (Macaca mulatta) were irradiated at midline tissue doses of 405 to 1540 rads of pulsed γ-neutron radiations from a TRIGA reactor. The study was performed to obtain lethality data and to record the clinical behavior of the monkey in this dose range. At doses of 500 rads or less, most of the deaths could be attributed to hematopoietic damage, although some animals displayed evidence of gastrointestinal involvement. Survival time was found to be independent of dose in the range of 800 to 1500 rads where deaths appeared due to gastrointestinal injury. A survival-time curve for doses ranging from 336 to 73,000 rads was completed by combining these data with results of previous studies at the AFRRI. From the combined survival-time curve, survival times in the monkey consistent with the CNS syndrome predominate at doses of 4300 rads and above. Postirradiation observations including weight change, food and water consumption, vomiting, diarrhea, and necropsy findings are discussed. (auth)

43394 (BNWL-531-3) INDUCED RADIONUCLIDES IN ASTRONAUTS. Quarterly Activity Report to the NASA, Ames Research Center, January 1, 1968–April 1, 1968. Brodzinski, R. L.; Wogman, N. A.; Perkins, R. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 17, 1968. Contract AT(45-1)-1830. 32p. Dep. CFSTI.

The absolute and relative production rates of ^{7}Be, ^{22}Na, and ^{24}Na were measured in tissue and tissue equivalent solutions exposed to high energy proton beams. The production rate of ^{7}Be was shown to be in reasonably good agreement with calculated production rates based on cross sections. The induced ^{7}Be as a function of radiation dose and energy were also in good agreement with the theoretical values. Of particular significance in this work, was the observation that the ratio of ^{7}Be to ^{24}Na increased smoothly as a function of increasing proton energy. The ratio of these radionuclides, therefore, allows one to determine the effective bombarding energy of the protons. Once this energy is known the irradiation dose can be determined directly from the experimental and theoretical curves that define activity per unit dose as a function of energy. The second significant observation was the high levels of ^{11}C produced in human patients on proton bombardment. From whole-body measurements of patients, it was established that a whole-body irradiated dose of 1 rad would produce approximately 1×10^6 dpm of ^{11}C. Measurement of this isotope in an astronaut during a space flight would be relatively simple and would provide direct information on his proton exposure. (auth)

43395 (CEA-R-3388) ETUDE D'UNE CONTAMINATION PAR 100 μCi DE ^{90}Sr CHEZ LE RAT: CONSEQUENCES CLINIQUES, HEMATOLOGIQUES ET OSSEUSES (APPARITION D'OSTEOSARCOMES). (Study of Contamination by 100 μCi of ^{90}Sr in the Rat: Clinical, Hematological, and Osseous Effects (Appearance of Osteosarcomas)). Graf, Beatrice; Lafuma, Jacques; Parmentier, Claude; Parmentier, Nicole (Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France). Centre d'Etudes Nucleaires). Feb. 1968. 22p. (In French). Dep.

Clinical, hematological and osseous effects following an intramuscular injection of 100 μCi ^{90}Sr were studied in the rat. In spite of the magnitude of the injection and the resulting damage, the elimination of strontium could compare with what occurs after an injection at tracer doses. Comparing with the controls at the outcoming time, clinical monitoring established a loss of body weight. Fairly early (20th to 30th day) there occurred severe hematological damage, especially on lymphocyte line, that subsided spontaneously. As foreseen, the anatomo-pathological survey of the early period showed bone and medular lesions in the areas of enchondral ossification. In the late period, bone sarcomas occurred in nine animals out of ten. The outstanding histological type was osteogenic osteosarcomas; besides, two animals experienced bilateral tumors. (auth)

43396 (EUR-3946) INVESTIGATIONS ON BONE MARROW TRANSPLANTATION IN IRRADIATED ANIMALS. Annual Report, 1966. (Gezondheidsorganisatie TNO, Rijswijk (Netherlands). Radiobiologisch Instituut). Apr. 4, 1968. 16p. Dep.

Methods aimed at the selection of bone marrow donors with maximum histocompatibility with regard to the irradiated recipients were investigated. Most of the work carried out during 1966 was on the typing of leucocyte antigens, as is currently being pursued in man. A major advance in the control of secondary disease was achieved by the introduction of anti-lymphocyte serum to treat the bone marrow recipients after the transplantation. (auth)

43397 (EUR–4032) INVESTIGATIONS ON BONE MARROW TRANSPLANTATION IN IRRADIATED ANIMALS. Report Covering the Period, January 1–December 31, 1967. (Gezondheidsorganisatie TNO, Rijswijk (Netherlands). Radiobiologisch Instituut). Apr. 4, 1968. 14p. Dep.

During 1967 the identification of primate leukocyte antigens was continued and a number of new candidate leukocyte antigens was added. In addition the study of erythrocyte groups and their significance for transplantation immunology was initiated. On the subject of anti-lymphocyte serum most of the efforts concentrated on the procedure for the production and purification of the agent. Major progress was made by the finding that anti-human lymphocyte serum is highly immunosuppressive in chimpanzees, which enables a more rational evaluation of the agent for clinical purposes. The studies concerning the radio-sensitivity of the immune system have concentrated on the recovery process after irradiation and on the role of the macrophages in the initiation of the immune responses. (auth)

43398 (NP–17495) SOSTOYANIE NERVNOI SISTEMY U DETEI V OTDALENNYE SPOKI POSLE LUCHEVOGO VOZDEISTVIYA. (Radiation Effects on the Nervous System in Children). Tereshchenko, N. Ya. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1968. 17p. (In Russian). Dep.

A brief review is given of irradiation effects on children. Analysis of the available experimental data indicated that irradiation during morphogenesis even with small doses of 10 to 30 R may induce serious alterations in the central nervous system. The changes may appear even after a prolonged latent period (up to mature age) and may be expressed in morphological, neurophysiological and behavioral disturbances. Local radio-therapeutic doses to the head of young children resulted, after a certain period, in various pathologic symptoms that were traced to the radiation injuries. Therapeutic x ray doses resulted in certain functional shifts of the central nervous system that were of reversible character. Radiotherapy of young children suffering from malignant or benign tumors in the head or nose and throat vicinity resulted in serious injuries to the brain. Retrospective analysis of the results of irradiation during early childhood showed that neuropsychologic functions may be affected at later years even after exposures to total doses of 200 to 400 R. 88 references are included. (R.V.J.)

43399 ACUTE RADIATION INJURY OF BONE MARROW AND THE EARLY PHASE OF ITS REGENERATION. Shimamine, T.; Takahama, M.; Ito, U.; Adachi, Y.; Tsunakawa, S.; Kamiyama, R.; Miyake, S.; Koike, M. (Tokyo Medical and Dental Univ.). Acta Pathol. Jap., 17: 317-19(Aug. 1967).

To study the mode of acute injury and of the early phase of regeneration in x-irradiated bone marrow of rats, cytological, histological, electron microscopic, and autoradiographic methods were applied. A single whole-body irradiation dose of 500, 700, or 1000 R was given, and other rats received a single local irradiation of 2000 R on their posterior limb with other parts of the body shielded. At three hr after irradiation, morphological evidence of bone marrow cell injury was hardly discernible except that the nucleoli of some erythroblasts were smaller in size. After 12 hr, various features indicated degenerative processes in most erythroblasts that appeared to be phagocytized by reticulum cells. Erythroblasts almost completely disappeared by the 24th hr. The number of granulocytic cells began to decrease on the second day and reached a minimum on the third day. Degenerative processes in granulocytic cells were less than in erythroblasts. However, dilatation of endoplasmic reticulum (ER), swelling of mitochondria, pleomorphism of specific granules, and migration of organelles and granules toward the perinuclear region represented degenerative changes. Megakaryocytes began to exhibit alterations such as marked dilatation of ER on the second day. Many megakaryocytes had only an attenuated layer of cytoplasm surrounding a lobulated nucleus. Alteration and increased permeability of the sinusoidal wall appeared to influence the injury to bone marrow Intravenous administration of India ink showed that permeability through the sinusoidal walls was markedly increased as early as three hr after irradiation. Fat cells obviously increased in number after the second or third day. Foci of early regeneration of erythro- and granulopoietic cells first appeared around the third day. Granulopoiesis predominated over erythropoiesis and megakaryopoiesis. (BBB)

43400 INTERACTION OF GAMMA IRRADIATION AND SALINITY ON RESPIRATION OF BRINE SHRIMP (ARTEMIA SALINA) NAUPLII. Angelovic, J. W.; Engel, D. W. (Bureau of Commercial Fisheries, Beaufort, N. C.). Radiat. Res., 35: 102-8(1968).

Respiration rates and Q_{10}'s of 1-day-old brine shrimp nauplii were affected significantly by radiation, the salinity of the water, and the interaction between the two factors. Respiration rates were measured in salinities from 5 to 200‰. Irradiated nauplii received doses of ^{60}Co radiation of 10,000 to 80,000 rads. In general, respiration rates of irradiated nauplii were significantly lower than those of unirradiated nauplii at salinities of 5, 50, and 200‰, but were higher at 100 and 150‰. When nauplii were in the highest salinity, 200‰, each increase in radiation above 10,000 rads caused a corresponding decrease in the rate of respiration. Similarly, at each salinity the nauplii exposed to the highest radiation dose, 80,000 rads, had the lowest rate of respiration. The highest levels of radiation and salinity acted synergistically and depressed the respiration rate to the lowest point. The greatest effect on Q_{10}'s was at the highest salinity. At this salinity, Q_{10} values for all irradiated nauplii were significantly lower than for controls or for irradiated nauplii at other salinities. (auth)

43401 CELLULAR COMPOSITION OF MOUSE THYMUS AFTER X-RAY EXPOSURE. Blomgren, H.; Revesz, L. (Karolinska Institutet Medical School, Stockholm). Exp. Cell Res., 51: 92-104(July 1968).

The composition of the cell population in mouse thymus was studied quantitatively using cell volume as a particular cellular marker characteristic determined by electronic particle size analysis. In unirradiated mice, an exponential increase of the cell population was found after birth, followed by a gradual decrease during the age involution of the organ. Small size cells increased in frequency with increasing age. In the thymus of x-irradiated mice, the number of small size cells decreased to a smaller extent than large size cells after x-ray doses lower than 200 R but, in contrast, to a greater extent after larger doses. Repopulation of the irradiated organ followed a cyclic pattern, the repopulation by large size cells preceding, as a rule, that by small size cells. The relevance of the observations in indicating a differential sensitivity of thymus cells of different size, and the origin of small size cells from large size cells was discussed. (auth)

43402 MINIMUM CLONE SIZE FOR ESTIMATING NORMAL REPRODUCTIVE CAPACITY OF CULTURED CELLS. Nias, A. H. W.; Fox, Margaret (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Brit. J. Radiol., 41: 468-74(June 1968).

The end-points used for estimating the survival of γ irradiated mammalian cells are discussed. The single-cell cloning method as used for monolayer cultures in vitro is a much less demanding criterion of survival than those used for mammalian cells growing in vivo and also for suspension cultures in vitro. Comparisons were made of the survival levels of HeLa cells in monolayer culture and P388F lymphoma cells in suspension culture, using the end-points of clone-forming ability and backward extrapolation from growth curves. With the monolayer cultures the usual minimum clone size is 50 cells and with this criterion much higher levels of survival were found in comparison with those from growth curves. This discrepancy could be removed when a larger minimum clone size was used for the end-point. With the suspension cultures the levels of survival obtained from agar clones were in agreement with those from growth curves. The minimum agar clone size was already larger than 50 cells and survival was assessed earlier, i.e., a more demanding end-point was used. It is proposed that the various end-points can be reconciled if the more demanding criterion is used of survival of normal reproductive capacity. (auth)

43403 EFFECTS OF TEMPERATURE ON SKIN RADIATION REACTION. Jolles, B.; Harrison, R. G. (General Hospital, Northampton, Eng.). Brit. J. Radiol., 41: 448-51(June 1968).

The vascular permeability changes induced by topical x irradiation of rabbit skin was decreased or abolished by keeping the animals at raised temperatures (38.5°C) prior to irradiation.

Cooling the animals (2.5°C) for a similar period did not significantly affect the postirradiation vascular permeability. The vascular permeability change caused by heating the animals was reversible, in contrast with the longer-lasting change in vascular permeability resulting from whole-body irradiation. Some of the possible mechanisms are briefly discussed. (auth)

43404 ELECTROCARDIOGRAPHIC ABNORMALITIES FOLLOWING POST-OPERATIVE RADIOTHERAPY FOR CARCINOMA OF THE BREAST. Andrews, J. T.; Etheridge, M. J. (Cancer Inst., Melbourne). Brit. J. Radiol., 41: 452-4(June 1968).

Electrocardiograms were recorded prior to, and one month and six months after x radiation therapy in 35 patients who had radical mastectomy for carcinoma of the breast. There were three instances of a change in the electrocardiogram following such therapy. These changes were non-specific and their significance is briefly discussed. (auth)

43405 MYELOPATHY FOLLOWING TELETHERAPY WITH RADIOACTIVE COBALT. Ferrero, R. G. A.; Obarrio, J. M. (Hospital Rivadavia, Buenos Aires). J. Neurol. Sci., 2: 446-50 (Sept.-Oct. 1965).

A case of myelopathy due to ^{60}Co teletherapy during the course of treatment of lung cancer is presented. Spinal symptomatology began almost 3 yr after the last application of radiotherapy to the lung. Neurological symptoms started with paraesthesia in the lower limbs followed by ataxic paraparesis with associated sensory impairment, and a sensory cord level at the 6th dorsal segment. The level of the spinal cord injury coincided with the level of pigmented injured skin. It is generally accepted that doses below 5000 R do not produce necrotic injuries within the central nervous system. However, this figure is not an absolute rule and, according to individual susceptibility, lower levels may be at risk, depending also upon the type of field utilized and the interval between individual applications. The possibility of the existence of individual predisposition in such cases cannot be rejected. The vulnerability seems to be greater in the case of the cervical spinal cord, possibly on account of the large number of neighboring structures that may require radiotherapy. Out of a previous series of 116 cases, 6% developed myelopathic sequelae after therapeutic irradiation in the paravertebral regions. (BBB)

43406 OBSERVATIONS CONCERNING A CASE OF OCCUPATIONAL EXPOSURE TO ^{137}Cs. Zanardi, S.; Bonsignore, D. Lav. Med., 20: 237-46(Sept.-Oct. 1966). (In Italian).

A case is described in which a ^{137}Co γ source used in industrial radiography equipment was accidentally left outside of the container, and a worker was consequently exposed to gamma radiation for a total of some 300 hr, the accumulated dose amounting to between 18,000 and 37,000 mRem. The incident is discussed in the light of recent research on the effects of ionizing radiation on the chromosomes. Two karyograms revealing the presence of unstable chromosome changes are reproduced and discussed. (Occup. Safety and Health Abstr.)

43407 RELATIONSHIP BETWEEN AGE AT IRRADIATION AND LIFE-SHORTENING IN ADULT DROSOPHILA. Lamb, Marion J. (Birkbeck Coll., London). pp 163-74 of Radiation and Ageing. Lindop, Patricia J. (ed.). London, Taylor and Francis Ltd., 1966.

From International Colloquium on Radiations and Ageing, Semmering, Austria, June 23-24, 1966. See CONF-660635.

The advantages of using Drosophila as an experimental animal for investigating radiation-induced life-shortening are discussed and the results of experiments using young flies are outlined. With older flies it was found that the percentage reduction in the further expectation of life per unit dose was constant over part of the age and dose range, but there was some evidence that flies irradiated with high doses showed an increase in sensitivity with age. The hypotheses that radiation accelerates the natural ageing process or causes precocious ageing are discussed and it is concluded that the data are more compatible with the accelerated ageing hypothesis than with precocious ageing. It is suggested that the increase in sensitivity with increasing age at irradiation with high doses can be explained if irradiation causes two types of injury, one of which occurs immediately after irradiation and can be repaired, and one which is irreparable and has a delayed effect. (auth)

43408 DIFFERENTIAL GERONTOMIMETIC EFFECTS OF X-IRRADIATION TO PUPAE OR MALE AND FEMALE HOUSE FLIES. Rockstein, M. (Univ. of Miami, Fla.). pp 175-8 of Radiation and Ageing. Lindop, Patricia J. (ed.). London, Taylor and Francis Ltd., 1966.

From International Colloquium on Radiations and Ageing, Semmering, Austria, June 23-24, 1966. See CONF-660635.

Doses of x radiation below 10 krad did not significantly affect emergence and longevity when applied to 36- to 48-hour old pupae of Musca domestica. Doses above 10 krad caused a decrease in longevity in females but the average life span of males was increased after doses of 10 and 15 krad and equal to the control after 20 krad. Doses of 30 krad resulted in shortened life spans in both sexes. Wing loss (a senescent phenomenon) at the time of death was virtually eliminated in both sexes at doses of 30 krad. (M.M.B.)

43409 BIOPHYSICAL EFFECTS OF LASER RADIATION. Tomberg, Victor T. (New York Medical Coll.). pp 59 of Proceedings of the 19th Annual Conference on Engineering in Medicine and Biology, San Francisco, California, November 14-17, 1966. Volume 8. Vurek, Gerald G. (ed.). New York, Institute of Electrical and Electronics Engineers, and Pittsburgh, Instrument Society of America, 1966.

See CONF-661119.

43410 LONGEVITY AS INFLUENCED BY IRRADIATION IN GERMFREE MICE. Walburg, H. E. Jr.; Cosgrove, G. E.; Upton, A. C. (Oak Ridge National Lab., Tenn.). pp 361-5 of Radiation and Ageing. Lindop, Patricia J. (ed.). London, Taylor and Francis Ltd., 1966.

From International Colloquium on Radiations and Ageing, Semmering, Austria, June 23-24, 1966. See CONF-660635.

In order to study the effects of microbial environment on aging, germfree and conventional x-irradiated and unirradiated mice were examined for life span and disease incidence. Radioinduced senescent changes and life-shortening occurred in both groups. Although the survival curves of the germfree mice had different forms and longer average life spans than those of conventional mice, the maximum life spans were about the same in both groups. (M.M.B.)

43411 POSSIBLE FINAL COMMON PATHWAY FOR NATURAL AGEING AND RADIATION INDUCED LIFE SHORTENING. Kohn, R. R. (Western Reserve Univ., Cleveland). pp 373-92 of Radiation and Ageing. Lindop, Patricia J. (ed.). London, Taylor and Francis Ltd., 1966.

From International Colloquium on Radiations and Ageing, Semmering, Austria, June 23-24, 1966. See CONF-660635.

Data that support an hypothesis to explain mammalian aging and radioinduced acceleration of aging are discussed. Aggregation or cross linking of collagen throughout the body can explain almost all of the manifestations of age by its effect on diffusion processes and tissue motility. Radiation injures endothelial cells and results in widespread arteriolocapillary fibrosis. An increase in fibrous connective tissue proteins would be expected to have the same physiological effects as the aggregation of such proteins with age. Suggestions for future research are made. (M.M.B.)

43412 PHYSIOLOGIC MECHANISMS OF INJURY AND RECOVERY FROM ELECTROMAGNETIC RADIATION. Michaelson, Sol M. (Univ. of Rochester, N. Y.). pp 393-409 of Radiation and Ageing. Lindop, Patricia J. (ed.). London, Taylor and Francis Ltd., 1966.

From International Colloquium on Radiations and Ageing, Semmering, Austria, June 23-24, 1966. See CONF-660635.

A model was developed that related radiation injury and recovery to diminished reserve capacity and alterations in the regulatory mechanisms required for homeostasis. Exposure of specific portions of the body to x irradiation resulted in injury to selected organs or organ systems. Since selective radiation injury was compatible with survival of the organism beyond the acute phase, the functional capacity of the organ system in relation to interdependent regulatory and integrative components of the body could be investigated. As a result of selective irradiation, disturbance of cardiopulmonary, thyroid, and erythropoietic function as well as exercise performance was studied. The results of these studies in dogs indicated an earlier waning in vital capacity of the irradiated organism. Such individuals had to maintain themselves at a lower level of physiological efficiency. The resultant residual injury from radiation exposure could be considered to be the difference in reserve capacity of the irradiated individual between that which was then available and that which would have been available if he was irradiated. (auth)

43413 CHRONIC IRRADIATION AND AGEING IN MICE AND RATS. Lesher, S. (Argonne National Lab., Ill.). pp 183-206 of Radiation and Ageing. Lindop, Patricia J. (ed.). London, Taylor and Francis Ltd., 1966.

From International Colloquium on Radiations and Ageing, Semmering, Austria, June 23-24, 1966. See CONF-660635.

When mice were exposed to continuous whole-body ionizing radiation, the effects on the proliferative cells of the crypts of the small intestine by the end of the first exposure day were similar to those produced by a single low-dose exposure, in that cells were retarded as they moved through G$_2$ and M but were not completely blocked in either of these phases. The retardation of cells in G_2 and M increased in response to an increase in dose. Within a few days (less than 3 days) the labeled mitotic figure curves were similar in shape to those of cells in non-irradiated animals, with no evidence of a G_2 or M effect. The duration of the generation cycle was also reduced. During long continued irradiation the crypt cells were able to maintain this accelerated cycle. The degree of the acceleration was dose dependent but a minimum cycle duration was reached that was independent of age. The generation cycles of both mice and rats, exposed to 50 rad/day for 12 days and 220 R/day for 7 days, were reduced to 8 or to 9 hrs while the generation time (GT) in mice exposed to 12 R/day (100-day-old, 400-day-old, and 825-day-old BCF_1 mice) plateaued at about 12 hours after 10 days exposure. Since there was little change in $S + G_2 + M$ phases, the cells spend less time in G_1. Estimates of the GT of the intestinal crypt cells of mice exposed to 12 R/day of continuous ^{60}Co γ irradiation showed that the cell cycle, within 1 to 10 days after the start of exposure, was reduced to about 12 hours and that it was able to maintain this accelerated cycle for an extended period. However, the reduction in the GT at 12 R/day was much less than the maximum reduction produced by 50 rad/day (GT of 12 hours, vs. 8 hours respectively). (auth)

43414 PRELIMINARY RESULTS FROM A SPLIT DOSE EXPERIMENT ON LATE EFFECTS OF IONIZING RADIATION IN THE MOUSE. DATA ON LIFE SPAN SHORTENING. Silini, G.; Metalli, P. pp 207-15 of Radiation and Ageing. Lindop, Patricia J. (ed.). London, Taylor and Francis Ltd., 1966.

From International Colloquium on Radiations and Ageing, Semmering, Austria, June 23–24, 1966. See CONF-660635.

A study was made to analyze the early recuperative events after a first dose of x radiation followed by a second dose after short, increasing intervals. Data from 544 irradiated mice were to be analyzed for effects on life span and induction of neoplastic diseases. The data presented are preliminary and include only a partial analysis of post-irradiation survival times. (M.M.B.)

43415 EFFECTS OF LIFETIME PERIODIC GAMMA-RAY EXPOSURE ON THE SURVIVAL AND PATHOLOGY OF GUINEA PIGS. Rust, J. H.; Robertson, R. J.; Staffeldt, E. F.; Sacher, G. A.; Grahn, D.; Fry, R. J. M. (Univ. of Chicago). pp 217-44 of Radiation and Ageing. Lindop, Patricia J. (ed.). London, Taylor and Francis Ltd., 1966.

From International Colloquium on Radiations and Ageing, Semmering, Austria, June 23–24, 1966. See CONF-660635.

Guinea pigs were exposed to fractionated whole-body irradiation with ^{60}Co γ rays. The relation between the logarithm of the mean after survival time and weekly dose is approximately linear and the life-shortening coefficient is about 0.06 days/R. The accumulated percentages of guinea pigs of each sex dying by 250-day periods reveal that at the 5.4 R/week dose rate the mortality of males is decreased when compared to unirradiated animals. Pathological examination failed to reveal an explanation for this radioinduced increase in life span. (M.M.B.)

43416 AGE DEPENDENCE OF RADIOSENSITIVITY OF MOUSE OOCYTES. Peters, Hannah (Finsen Inst. and Radiumstation, Copenhagen). pp 281-92 of Radiation and Ageing. Lindop, Patricia J. (ed.). London, Taylor and Francis Ltd., 1966.

From International Colloquium on Radiations and Ageing, Semmering, Austria, June 23–24, 1966. See CONF-660635.

Mice were irradiated with single doses of 20 R of x rays at ages that varied from one week to 49 days in order to study the effects of age on the radiosensitivity of oocytes. Survival of the oocytes was assessed quantitatively and the reproductive performance of the mice was measured. The variation in radiosensitivity did not show a simple relation to the age of the mouse but went through a maximum at the time of puberty. Irradiation of the ovary at different ages apparently influenced different stages of oocyte development, each of which carried its own sensitivity. (M.M.B.)

43417 EFFECT OF 25 R OF X-RAYS AT 10 DAYS OF AGE ON OOCYTE NUMBERS AND FERTILITY OF FEMALE MICE. Oakberg, E. F. (Oak Ridge National Lab., Tenn.). pp 293-306 of Radiation and Ageing. Lindop, Patricia J. (ed.). London, Taylor and Francis Ltd., 1966.

From International Colloquium on Radiations and Ageing, Semmering, Austria, June 23–24, 1966. See CONF-660635.

X irradiation ten days postnatal reduced the total productivity of 101 × C_3H female mice to 35% of control. The primary factor in this reduction of fertility was radiation-induced degeneration of oocytes. Two types of radiation-induced killing of mouse oocytes were observed. The first resulted in rapid loss of oocytes immediately after irradiation; the second led to an enhanced rate of degeneration in follicle stages 1 to 5 throughout the reproductive span of the irradiated female. The rate of loss of oocytes with age was significantly greater in irradiated females. Control of ovulation was such that with reduction in the number of oocytes, a compensation occurred that led to ovulation of close to the normal number of eggs at each estrus. Productivity of irradiated females was better than was expected on the basis of reduction of the oocyte supply to only about 4% of control. The explanation of this paradox lies in the fact that 4% of the normal number of oocytes, used during the peak productive age of the female, is enough for the early litters. Whereas irradiated females became sterile because the oocyte supply was exhausted, control females became sterile with an ample supply of oocytes still in the ovary. Therefore, radiation-induced sterility in the female mouse was not an enhanced ageing phenomenon, since the cause of sterility was different in irradiated and control females. (auth)

43418 EFFECT OF AGE AND HYPOXIA ON THE LONG-TERM RESPONSE OF THE OVARY TO RADIATION. Lindop, Particia J.; Rotblat, J.; Vatistas, S. (St Bartholomew's Hospital, London). pp 307-24 of Radiation and Ageing. Lindop, Patricia J. (ed.). London, Taylor and Francis Ltd., 1966. (ORNL-P-1956).

From International Colloquium on Radiations and Ageing, Semmering, Austria, June 23–24, 1966. See CONF-660635.

Female mice were exposed to single whole-body doses of 15 MeV electrons at a dose rate of 320 rad/sec at ages between one day and 16 weeks. During irradiation the mice were breathing either oxygen, air, or nitrogen. The reproductive capacity of the females was measured using reproductive life span, number of litters per mother, number of mice per litter, and the total number of mice per mother. The total number of oocytes in ovaries of mice killed at different times after exposure was used to assess cell survival. The results confirm the age dependence of oocyte radiosensitivity. Irradiation under conditions of hypoxia appears to be more effective in reducing cell number and reproductive capacity than an equal dose given in air. (M.M.B.)

43419 AGEING AND NEOPLASIA FOLLOWING TRITIATED THYMIDINE INJECTION IN MICE. Mewissen, D. J. (Univ. of Brussels). pp 329-35 of Radiation and Ageing. Lindop, Patricia J. (ed.). London, Taylor and Francis Ltd., 1966.

From International Colloquium on Radiations and Ageing, Semmering, Austria, June 23–24, 1966. See CONF-660635.

A study was made of the effect of neonatal tritium-labeled thymidine injection on the life span and the incidence of lymphosarcomas and other tumors in C 57 BL mice. No shortening of the life span was demonstrated. Preliminary results on the incidence of lymphosarcomas in the mice were inconclusive although a single injection of 0.3 or 0.4 μCi appeared to cause an increase in incidence. (M.M.B.)

43420 INFLUENCE OF AGE AT IRRADIATION ON SUSCEPTIBILITY TO RADIATION-INDUCED LIFE-SHORTENING IN RF MICE. Upton, A. C.; Conklin, J. W.; Popp, R. A. (Oak Ridge National Lab., Tenn.). pp 337-44 of Radiation and Ageing. Lindop, Patricia J. (ed.). London, Taylor and Francis Ltd., 1966.

From International Colloquium on Radiations and Ageing, Semmering, Austria, June 23–24, 1966. See CONF-660635.

Non-inbred male and female RF mice were exposed to 50 to 400 R whole-body x rays at ages ranging from $9\frac{1}{2}$ days after conception to one yr after birth. In mice of both sexes, irradiation after birth shortened the life span, the effect per unit dose being largest at the higher dose levels (300 to 400 R) and in the groups exposed at 40 to 70 days of age. In mice exposed before birth, life-shortening was consistently less marked than in those exposed after birth, except in the males irradiated early in development at the highest dose level administered prenatally (i.e., 300 R at $14\frac{1}{2}$ days after conception). These males died with runting and microcephaly after a mean survival time of only 6 to 7 months from causes yet to be determined. They failed to show the typical spectrum of neoplastic and non-neoplastic lesions associated with life-shortening and ageing in the other groups. The relatively low susceptibility of all other prenatally irradiated mice to radiation-induced life-shortening and carcinogenesis was paradoxical and remains to be explained. (auth)

43421 RADIATION AND AGEING. Proceedings of a Colloquium held in Semmering, Austria, June 23–24, 1966. Lindop, Patricia J.; Sacher, G. A. (eds.). London, Taylor and Francis Ltd., 1966. 469p. $6.50; £2.5.0. (CONF-660635).

Twenty-five papers are presented on radiation and aging in the following areas: growth, regeneration and renewal systems; mechanism of genetic damage in somatic cells; life-shortening in non-mammalian organisms; long-term pathology and lifespan; effect of age and radiation on the ovary; neoplasia and aplasia; and theories of aging and models of radiation effects. Separate abstracts for 20 papers have been prepared. (M.M.B.)

For abstracts of individual papers see: 43224, 43225, 43285, 43286, 43360, 43407, 43408, 43410–43420, 43422, and 43430.

43422 RADIATION-INDUCED AGEING LESIONS IN RODENT KIDNEY: EXPERIMENTAL ALTERATION BY UNINEPHRECTOMY, FOOD RESTRICTION AND AGE OF IRRADIATION. Cole, L. J.; Wachtel, L. W.; Rosen, V. J. Jr. (Naval Radiological Defense Lab., San Francisco). pp 23–42 of Radiation and Ageing. Lindop, Patricia J. (ed.). London, Taylcr and Francis Ltd., 1966.

From International Colloquium on Radiations and Ageing, Semmering, Austria, June 23–24, 1966. See CONF-660635.

The occurrence and development of glomerulosclerosis and renal neoplasms in x-irradiated mice and rats are discussed. Glomerulosclerosis is a kidney lesion occurring in old animals and its frequency and severity is increased by x irradiation. Results are reported from studies on the effects of unilateral nephrectomy, food restriction, and age at the time of irradiation on the development of glomerulosclerosis; the effects of fractionation of the radiation dose in the 200 rad range on the development of glomerulosclerotic lesions in adult and weanling rats; the development of renal neoplasms in mice exposed to x radiation at birth or at three months of age; the effects of single and fractionated doses of x radiation on the content of DNA in one kidney after extirpation of the other kidney; and the influence of indirect effects on radiation, as manifest by depressed DNA synthesis, on the development of late kidney lesions. The complexities of the problem of radiation and aging are discussed. It is postulated that the induction of premature aging does not involve all organs and tissues in a given individual to the same extent and that the development of this aging depends on many variables, that may be different for different tissues and organs. (C.H.)

43423 RECOVERY PROCESSES IN X-IRRADIATED MAMMALIAN CELLS. Whitmore, G. E.; Gulyas, S. (Univ. of Toronto. Ontario Cancer Inst., Toronto). pp 370–88 of Canadian Cancer Conference. Vol. 7. Morgan, J. F. (ed.). New York, Pergamon Press, 1967.

From 7th Canadian Cancer Research Conference, Honey Harbour, Ontario, Canada, June 1966. See CONF-660658.

Synchronized L-cells were irradiated at different stages in the cell cycle. The results indicated that in addition to non-repairable radioinduced lesions there were also radioinduced lesions with the potential of causing cell death or of being repaired. In split dose experiments population survival was determined by age distribution of cells, rate of damage incorporation, and rate of damage repair. Damage in slowly metabolizing cells appeared to be repaired more efficiently than damage in rapidly metabolizing cells. Possible applications of these results to radiotherapy of tumors are discussed. (M.M.B.)

43424 EFFECTS OF RADIATION ON TUMORS IN ANIMALS. Suit, Herman D. (Univ. of Texas, Houston). pp 389–404 of Canadian Cancer Conference. Vol. 7. Morgan, J. F. (ed.). New York, Pergamon Press, 1967.

From 7th Canadian Cancer Research Conference, Honey Harbour, Ontario, Canada, June 1966. See CONF-660658.

A model tumor tissue was developed to provide a basis upon which radiobiology of solid tumors might be discussed. First, tumor cell radiosensitivity was reviewed: D_0 values for 14 mammalian tumor cell lines were found to approximate a log normal distribution with a median of 350 rads, irradiated under hypoxic conditions. Then factors limiting usefulness of various endpoints that may be employed in solid tumor radiobiology were discussed. This was followed by a discussion of radiation dose-tumor control response curves with respect to factors that would influence its slope. Finally, an example was presented of the way in which even the elementary experiments that we may perform today can be of use in providing guide lines in planning clinical trials. (auth)

43425 CANADIAN CANCER CONFERENCE. VOLUME 7. Proceedings of the Seventh Canadian Cancer Research Conference, Honey Harbour, Ontario, June 1966. Morgan, J. F.; Noble, R. L.; Rossiter, R. J.; Taylor, R. M.; Wallace, A. C.; Whitelaw, D. M. (eds.). New York, Pergamon Press, 1967. 438p. $18.00. (CONF-660658).

Under the sponsorship of the National Cancer Institute of Canada, the present volume is a collection of 22 research papers. Among the topics covered are cell proliferation in normal and neoplastic tissues, metabolic regulation, cell surfaces, the nature of cancer (with discussion of epidemiology as well as carcinogenic mechanisms), and radiobiology. The four papers in the last area were abstracted separately. (M.M.B.)

For abstracts of individual papers see: 43223, 43359, 43423, and 43424.

43426 PHOTOSENSITIVE DERMATITIS FROM SOAPS. Ison, A. E.; Tucker, J. B. (Univ. of Miami, Fla.). New Engl. J. Med., 278: 81-4(Jan. 11, 1968).

Ultraviolet irradiation was employed in 12 patients to study photosensitive eruptions to halogenated salicylanilides in soaps, as seen by positive photopatch tests. Results of tests to determine which of the halogenated salicylanilides was more likely to cause photosensitive dermatitis were detailed. A test system using a uv light source was designed to study the patients and offered a reliable and simple method while providing some distinct advantages over previous ones. The photosensitive reaction typically appeared as a sharply demarcated, moderately severe, acute and chronic eczematous dermatitis limited to the exposed parts of the body. A combination of a chemical compound and uv light was required to produce the disease; neither alone would cause a photosensitive eruption. For the photopatch tests the compounds on gauze pads were applied to each patient's back. They were left in place for 48 hr and removed. One side of the back was then shielded from light and the opposite side was uv irradiated. All patients with photosensitive dermatitis had positive photopatch tests to either tribromosalicylanilide, dibromosalicylanilide, or a soap solution containing these substances. All photopatch tests were positive at 24 hr. Only uv wavelengths between 320 and 400 nm were necessary to elicit positive photopatch tests with halogenated salicylanilides. The uv lamp used in this study had a substantial output above 320 nm. Irradiation with uv light shorter than 320 nm caused erythema on normal skin. The erythema obscured positive photopatch tests and made interpretation very difficult. When windowglass, which filters wavelengths below 320 nm, was placed between the lamp and the area to be irradiated, no erythema was produced on normal skin, and the positive reactions at the sites of patch tests were easily seen. (BBB)

43427 PHASE CONTRAST MICROSCOPIC STUDY ON THE INDUCTION OF CELLULAR DEFORMATION IN MAST CELLS. Choi, Kum Duck; Oh, Yung Keun; Park, Dal Uck; Rhim, Kyu Soon; Cho, Tong Hun (Yosei Univ., Seoul). Yonsei Med. J., 7: 1-6 (1966).

The effect of ginseng-alcohol extract, saponin, garlic alcohol-ether extract, and x radiation on peritoneal mast cells of the rat was studied. The effect of colchicine and mast cell damaging agents as well as of metabolic poisons on the mast-cell system was also determined. After intraperitoneal injection of colchicine or colcemid the mast cells in the peritoneal fluid showed altered morphology. Ginseng-alcohol extract, allicin extracted from garlic, and x radiation did not elicit this cytologic response. The effect of 750 R radiation on peritoneal mast cells was similar to that seen following the garlic extract injection. All of the cellular components of the peritoneal fluid remained intact. Even 24 hr postirradiation, at the time of maximal decrease (64.0%) of the intact mesenteric mast cells, no changes were observed in the free peritoneal mast cells. Mast cells exposed to saponin exhibited severe destruction and degranulation. The relation of mast cell-damaging agents, metabolic poisons, and x radiation to the mast cell response was discussed with reference to the morphological changes. (BBB)

43428 MICROCEPHALIC MENTAL DEFICIENCY DUE TO A RADIOGENIC EMBRYOPATHY (CLINICOPSYCHOLOGIC STUDY OF A CASE FOLLOWED-UP FROM 14 YEARS AND 6 MONTHS UP TO THE AGE OF 20). Schachter, M. (Comite Regional d'Education et d'Assistance de l'Enfance Deficiente, Marseille). Praxis (Bern), 55: 1255-8(Nov. 3, 1966). (In French).

The clinical literature pertinent to radioinduced embryonic anomalies is reviewed, and a case history is presented of microcephalic mental deficiency due to radiogenic embryopathy. A girl aged 14 yr 6 months was examined for mental and physical retardation. Other children in the family and both parents were normal. The mother received deep Ra therapy for a sciatic condition during the first month of pregnancy. Her pregnancy was not known until after eight radiotherapy sessions; Ra treatment was then discontinued. The baby was normal at birth except for a small head. Retardation became more and more evident up to the time of examination. The girl was tested and placed in a special school under medical observation until age 20. Somatic development at that age was of a 14-yr-old, and mental age was equivalent to that of a 10-yr-old. (BBB)

43429 POPULATION EXPOSURE PROBABILITY MODEL FOR RANDOM RE-ENTRY OF A RADIOISOTOPE SOURCE. Easton, C. R.; Langley, R. W.; Anno, G. H. (Douglas Aircraft Co., Santa Monica, Calif.). Nucl. Appl., 5: 74-8(Aug. 1968).

A satellite carrying radioactive material in a near-Earth orbit has a finite probability of re-entering before the radioactivity has decayed to a harmless level. If the re-entry is unplanned, it is normally impossible to predict the impact point to a useful degree of accuracy. This paper deals with such cases. The probability distribution function for latitude of impact is derived for a general case. This function is then combined with an injury probability model and a population distribution model to compute probabilities of injury. The results are correlated as the dependence of probability of injury on latitude and orbital inclination angle. It is shown that probability of injury peaks for an orbital inclination of 30° to 60°. (auth)

43430 THE GOMPERTZ TRANSFORMATION IN THE STUDY OF THE INJURY-MORTALITY RELATIONSHIP: APPLICATION TO LATE RADIATION EFFECTS AND AGEING. Sacher, George A. (Argonne National Lab., Ill.). pp 411-41 of Radiation and Ageing. Lindop, Patricia J. (ed.). London, Taylor and Francis Ltd., 1966.

From International Colloquium on Radiations and Ageing, Semmering, Austria, June 23–24, 1966. See CONF-660635.

Mathematical and statistical techniques employed in the analysis of mortality data for evaluation of the inverse injury-mortality function are reviewed. A tabulation is presented of rate-of-mortality functions for six species of animals including man, allowing a quantitative comparison of the parameters of actuarial ageing in four orders of mammals. The effects of x- or γ-ray exposures on the life tables of four species are analyzed by the same techniques. The life-shortening coefficients of the different species are compared and implications for radioinduced life-shortening in human populations are discussed. Deficiencies of the present form of the theory are noted, and some appropriate experiments are outlined. (auth)

43431 INCORPORATION OF ^{14}C-ALANINE INTO NUCLEAR PROTEINS OF CELLS FROM REGENERATING LIVERS OF IRRADIATED AND UNIRRADIATED RATS. Blokhina, V. D.; Romantsev, E. F.; Romanova, L. F. (Inst. of Biophysics, Moscow). Biochemistry (USSR) (Engl. Transl.), 32: 944-6(Nov.-Dec. 1967).

Translated from Biokhimiya, 32: 1145-8(Nov.-Dec. 1967).

Partial hepatectomy of rats stimulated incorporation of ^{14}C-alanine into total nuclear proteins when isolated nuclei were incubated in vitro. An increase in tracer incorporation was observed 12 hr after surgery and was especially pronounced after 24, 48, and 72 hr. When partially hepatectomized rats were subjected to whole-body γ irradiation in the minimum absolutely lethal dose, the capacity of the nuclei to incorporate ^{14}C-alanine into their total proteins was reduced six, 24, 48, and 72 hr after surgery. (auth)

43432 ON THE ROLE OF DNA IN THE ULTRAVIOLET-SENSITIVITY OF CELL DIVISION IN SAND DOLLAR ZYGOTES. Cook, J. S. (Mount Desert Island Biological Lab., Salisbury, Me. New York Univ., N. Y.). Exp. Cell Res., 50: 627-38 (June 1968).

Cell division in zygotes of the sand dollar, *Echinarachnius parma*, is delayed by ultraviolet (uv) irradiation. UV-radiosensitivity is enhanced 2- to 3-fold after incorporation of 5′-bromodeoxyuridine (BUdR) into DNA: photoreactivability in such zygotes is greatly diminished or absent. These observations support the hypothesis that DNA is the responsible light absorber in uv-radioinduced cell division delay. The pattern of onset of hypersensitivity to uv indicated that delay in a given cleavage was the result of lesions in the DNA that were not replicated in the S period prior to that cleavage; lesions formed in DNA that, at the time of irradiation, had been replicated, were not expressed until the subsequent cell division. UV did not prolong the uv-radiosensitive portion of the cell cycle. This result implies that delay in (sensitive) DNA replication per se is not part of the overall mechanism of division delay. (auth)

43433 PATHOLOGICAL CHANGES IN BEAGLES AFTER SINGLE DOSES OF WHOLE-BODY GAMMA IRRADIATION. Zaldivar, Robert (Argonne National Lab., Ill.). Strahlentherapie, 135: 724-30(June 1968).

The pathological changes in 33 beagles of both sexes 408 to 440 days old following exposure to single doses of 275, 300, 325, 340, 350, or 365 R whole-body γ irradiation were investigated. Widespread hemorrhages, bacteremia, and hematopoietic depression were the major factors in acute radiation death. (auth)

43434 INFLUENCE OF LARGE QUANTITIES OF RADIOIODINE ON THE THYROID GLAND ON THE YOUNG ORGANISM. Kats'yuba-Ustilko, G. Med. Radiol., 13: No. 4, 34-7(Apr. 1968). (In Russian).

In experiments on chicks it was shown that the difference in the state of thyroid glands depended on the quantity of introduced ^{131}I and that scans manifested themselves in 48 hours. The administration of 150 mCi of ^{131}I per 100 gm of weight caused on the fifth day an almost complete destruction of the glandular parenchyma. The peripheral zone of the thyroid gland differed from the central one by a lesser accumulation of iodine in the follicular cavities. The thyroid reaction to ^{131}I administration depended on the species and age of animals, quantity of the isotope, and on the iodine level during normal and other conditions. (auth)

43435 ELECTRON-MICROSCOPIC STUDY OF EXPERIMENTAL MASUGY NEPHRITIS IN RABBITS BEFORE AND AFTER X-RAY IRRADIATION. II. Metev, M.; Petrova, E. Voenno Med. Delo, 22: No. 6, 27-32(Dec. 1967). (In Bulgarian).

The kidneys of rabbits were x irradiated at a dose of 600 R in the subchronic stage of experimental Masugy nephritis (on the 35th and 60th day after injection of nephrotoxic serum) and an electron microscope study was made. Comparison with the results obtained following irradiation in the acute stage of experimental Masugy nephritis (14th and 16th day after injection of the nephrotoxic serum) indicated that damage to the fine structure of the nephron was still present and even became more severe to a certain extent on the 35th day; it began to disappear on the 60th day. Rabbits irradiated in the acute state and sacrificed on the 16th and 35th day were compared with rabbits irradiated in the subchronic stage (on the 30th day) and sacrificed on the 35th day; in the latter, less pronounced alteration of the kidneys was observed. Irradiation affected the nuclei of all cells and to some extent the cytoplasm of tubular cells. (JPRS)

43436 EFFECTS OF THE COMBINED CYCLOPHOSPHAMIDE (ENDOXANE) AND IONIZING RADIATION ON THE PROLIFERATION PROCESSES IN NORMAL TISSUE. HISTOLOGICAL AND AUTORADIOGRAPHIC STUDIES WITH ^{3}H-THYMIDINE ON THE EPITHELIUM OF THE TONGUE AND SMALL INTESTINE OF THE MOUSE. PART I. Schuster, Reinhold (Univ., Goettingen, Ger.). Strahlentherapie, 135: 48-58(1968). (In German).

The effects of the combined application of endoxane and ionizing radiation on DNA formation and its time pattern were studied in comparison with the histologically detectable changes in normal proliferating tissues. The effect of the time gap between one or the other influence and its sequence on the total pattern of the changes was studied. The techniques and methods used in the studies on male white mice were reported. The effects on the small intestine of endoxane and whole-body irradiation used separately were first reported. These results were compared and contrasted with those obtained after combined simultaneous treatment with endoxane and whole-body irradiation. The effects of endoxane administered six or 12 hrs after whole-body irradiation were determined. (J.S.R.)

43437 THROMBODYNAMOGRAPHIC RESEARCH ON BLOOD COAGULATION ON PATIENTS TREATED WITH TELECOBALT THERAPY. Casassa, P. M.; Cugini, A.; Sosso, A.; Tognacca, M. (Univ., Turin). Minerva Radiol., 13: 65-75(Jan.-Feb. 1968). (In Italian).

The factors involved in the blood clotting process, including effects of x rays and other types of radiation, are reviewed. Platelet count changes and thrombodynamographic determinations were made on 93 patients treated with telecobalt therapy for tumors. Irradiation of the chest region resulted in an initial increase in blood clotting capacity with decreased firmness of the clot; irradiation of the abdominal region resulted in an initial delay in the blood clotting process with decreased firmness of the clot; irradiation of the neck region resulted in an initial decrease of the blood clotting with greater firmness of the clot. These observations are correlated with the significance of thromboplastin and the factors that condition its formation and activity. (H.L.W.)

43438 STIMULATION AND DEPRESSION OF PHAGOCYTOSIS IN RETICULO-ENDOTHELIAL SYSTEM BY X IRRADIATION. Flemming, K. (Univ., Freiburg i. B.). Experientia, 24: 545-6 (June 15, 1968). (In German).

The effect of x irradiation on the phagocytic activity of the reticulo-endothelial system in mice depends on the dose of carbon particles used as the test agent. Using small doses a stimulation was found; this indicates an increased velocity of carbon uptake by the phagocytes. Using high doses a depression was found indicating a decreased phagocytic capacity of the cells. (auth)

43439 RESPONSE OF MICE WITH A DECREASED NUMBER OF HEMATOPOIETIC STEM CELLS TO DOSES OF ERYTHROPOIETIN. Kilbridge, Thomas; Fried, Walter (Veterans Administration West Side Hospital, Chicago. Univ. of Illinois Coll. of Medicine, Chicago). J. Lab. Clin. Med., 72: 85-92(July 1968).

X-irradiated mice responded to any given dose of erythropoietin in a manner that was inversely proportional to the amount of radiation. They, however, retained the ability to respond to larger amounts of erythropoietin according to a dose response curve that was similar in shape to that in nonirradiated mice. Mice exposed to x irradiation with a leg shielded had a small, yet undamaged hematopoietic stem cell compartment. They also responded less well to any given dose of erythropoietin than did nonirradiated mice, and they had a dose response curve that was similar in shape to that of nonirradiated mice. Accordingly, it is probable that this alteration in response to erythropoietin was a reflection of a decrease in the size of the stem cell compartment and was not peculiar to a specific type of radiation induced cellular damage. These results are in accord with the following explanation: As the number of remaining stem cells becomes smaller, the chances decrease of any one cell coming into contact with sufficient erythropoietin molecules to trigger differentiation. Under these circumstances, erythropoiesis can be enhanced by increasing either the plasma erythropoietin titer, or the number of erythropoietin-responsive cells, or both. We suggest that this model may be applicable to understanding the mechanism of anemia in some patients with high plasma erythropoietin levels, who respond to agents that further increase this titer. (auth)

43440 FINGER GANGRENE AS LATE X-RAY INJURY: OBSERVATION OF A HERETOFORE UNDESCRIBED LATE RADIATION INJURY 45 YEARS AFTER X IRRADIATION OF SKIN CHANGES ON THE HAND OF A PATIENT WITH NEURODERMATITIS. Gnaediger, A.; Landes, E. (Hautklinik der Staedtischen Kliniken, Darmstadt, Ger.). Arch. Klin. Exp. Dermatol., 231: 170-86(Mar. 18, 1968). (In German).

Gangrene of the fingers is described in this case report as a special form of late lesions caused by x-ray therapy. The gangrene appeared in a patient with a neurodermatitis of 48 years duration, 45 years after the irradiation of the hands. On the basis of the reviewed literature it seemed to be a very rare form of late lesions caused by x-ray therapy. As an explanation of the pathological picture, it is suggested that the peripheral circulatory disorder typical for neurodermatitis led to the elevation of tissue resistance against radiation. This elevation of radioresistance prevented the expected tissue lesion from occurring. Also the hard x rays which probably were used for the treatment did not injure the soft parts of the hand. Yet in spite of the excellent vascular supply of the hand, much of the vascular system was injured so that necrosis resulted, based on the anatomic topographic features of the hand. The blood vessels and not the connective tissue, as usual, played an important role in the development of the lesions caused by the x-ray treatment. While the skin and connective tissue effectively resisted degenerative changes for a long period, the obliterating alterations of the vessels progressed gradually. They resulted in the scarring changes of the connective tissue and the atrophy of the small hand muscles and also in the shrinkage of the joints, accompanied by a diminution of mobility. The ischemia of the tissue increased progressively and finally resulted in necrosis. The mechanical stress on the right hand, especially of the index and middle finger, favored the development of necrosis without external injury to the hand being involved. (BBB)

43441 CALCIUM AND POTASSIUM METABOLISM IN LOCAL IRRADIATION OF LONG BONES. Shurygin, V. P. Med. Radiol., 12: No. 9, 56-8(Sept. 1967). (In Russian).

Metabolism of ^{32}P and ^{45}Ca in immature locally irradiated organisms was studied using 120 three-month-old rabbits exposed for 16 to 18 days to irradiation of the right tibia at 4400 rad dose (23.4 R/min, 200 R/exposure). Radiometric studies were made on the content of ^{32}P and ^{45}Ca in the peripheral blood and skeleton of the animals 4, 8, and 24 weeks following the exposure. Data obtained indicated that fractional, local irradiation of growing bone resulted not only in local injury but also inhibited general metabolism in the whole organism. (R.V.J.)

43442 MORPHOLOGICAL ALTERATION OF THE INTESTINE OF RATS IN PROLONGED INTRODUCTION OF ^{144}Ce INTO THE GASTROINTESTINAL TRACT. Lavrent'ev, L. N.; Grigoryan, Kh. V. (Leingrad Scientific-Research Inst. of Radiation Protection). Med. Radiol., 12: No. 9, 61-2(Sept. 1967). (In Russian).

Development of intestinal tract tumors induced by uptake of ^{144}Ce was studied using 225 male rats weighing 180 ± 15 g that were treated with 0.08 and 0.8 μCi ^{144}Ce introduced through a stomach tube during 180 days. Results showed that daily treatment with 0.08 μCi ^{144}Ce produced inflammatory swelling in the colonic tube (mucose tissue) that appeared 120 to 180 days posttreatment; a very superficial necrosis was present and the small intestines were not affected. Daily treatment with 0.8 μCi ^{144}Ce resulted in damage to the colon (mainly in the vicinity of the caecum). The changes appeared on the 10th day when the cumulative dose reached 26 rad; it reached the maximum when the total dose was equal to 312 to 468 ber. No tumors were observed during this period; however, inflamation and ulcerative–necrotic changes in the colon indicated possible tumor development at a later date. (R.V.J.)

43443 CONTACT PHOTODERMATITIS DUE TO TRIBROMOSALICYLANILIDE. **Osmundsen, P. E. (Finsen Inst., Copenhagen). Brit. J. Dermatol., 80: 228-34(Apr. 1968).**

Ultraviolet-radioinduced sensitivity to tribromosalicylanilide (TBS) was studied in 39 patients. All patients were found to be TBS sensitive. All were using a TBS-containing toilet soap when they developed dermatitis. Photopatch testing demonstrated the need for longwave uv irradiation in diagnosing TBS-photosensitivity. The results of photopatch testing in patients who received both a suberythemal dose of unfiltered uv and 30 min of uv filtered through window glass were shown. A heterogenous group of 45 patients served as controls. This group consisted of patients with polymorphic light eruption (three cases), phytophotodermatitis (three cases), and with a variety of other skin diseases (psoriasis, seborrhoeic dermatitis, contact dermatitis, atopic dermatitis, rosacea, perioral dermatitis, acne vulgaris) in which some aggravation by sun was said to occur. In these patients the uv photopatch tests were negative. Evidence was presented that TBS was a primary photosensitizer with a sensitizing potential approximately equal to that of tetrachlorosalicylanilide. The frequency of photosensitization was estimated as one per 1000 users. (BBB)

43444 EFFECT OF THE LASER ON CELLULAR RESPIRATION. **Rounds, Donald E. (Pasadena Foundation for Medical Research, Calif.); Olson, Robert S.; Johnson, Fred M. Z. Zellforsch. Mikroskop. Anat., 87: 193-8(Mar. 22, 1968).**

Laser radiation produced at a frequency of 5300 Å by a frequency-doubled Q-switched neodymium laser produced progressive injury and death of cells in a culture of newborn rat cerebellum. A subsequent observation that the green laser frequency (but not 6943 Å of the same intensity from a Q-switched ruby laser) could reduce the rate of oxygen consumption of rat brain cell suspensions suggested that the cytochromes might serve as chromophores. This hypothesis was confirmed by a demonstration that cytochromes c + c_1 failed to act as hydrogen acceptors following 10 impacts of 1 MW/cm^2 each of the green laser frequency and cytochromes a + a_3 showed a similar response when a brain cell suspension was irradiated (200 kW) with frequencies of 6096 and 6013 Å. These data illustrated the principle that laser frequencies that were appropriately matched to the absorption characteristics of target molecules could selectively inhibit specific molecular components in intact cells, if a controlled energy density range was used. (BBB)

43445 REACTIVITY OF THE ORGANISM IN COMBINED ACTION OF ULTRAVIOLET AND LONG-WAVE ROENTGEN RADIATION. Liberman, A. N.; Mostova, R. S. (Leningrad Scientific-Research Inst. of Radiation Protection). Med. Radiol., 12: No. 9, 62-3(Sept. 1967). (In Russian).

Microbiosis, production of antibodies, and antibacterial immunity in vaccinated animals and radioresistance during combined ultraviolet and x radiation were studied using 72 white female mice weighing 17 to 19 g and exposed to a dose of 4130 R. Combined irradiation by long wave x rays and uv rays resulted in a death rate of 60%; the death rate was 42% in animals exposed only to x rays. Similar results were obtained for animals exposed to combined uv and shortwave (73 keV) x rays. In animals exposed to uv with immediate exposure to 600 R x radiation, the death rate increased 25%. (R.V.J.)

43446 INFLUENCE OF IONIZING RADIATION ON THE DEVELOPMENT OF EXPERIMENTAL ENDOMYOCARDITIS. Aver'yanova, L. A. (Inst. of Normal and Pathological Physiology, Erevan). Med. Radiol., 12: No. 9, 55-6(Sept. 1967). (In Russian).

Experiments with 50 rabbits weighing 2.5 to 3 g and exposed to a single whole-body x irradiation at 300 R showed that without any visible disturbances in the heart activity, the exposure resulted in development of endomyocarditis. The mechanism of the induced effect was very complex. However, it was postulated that the changes in heart trophics were caused by direct injury to heart muscle, the nervous system elements, and to extracardial nerve regulations. (R.V.J.)

43447 AVERSION TO SUCROSE PRODUCED BY CONTINGENT X IRRADIATION: TEMPORAL AND DOSAGE PARAMETERS. **Revusky, Samuel H. (Army Medical Research Lab., Fort Knox, Ky.). J. Comp. Physiol. Psychol., 65: 17-22(Feb. 1968).**

Animals x-irradiated or injected with drugs after they consumed a flavored substance developed a specific aversion to that substance. The maximum time interval between ingestion and x irradiation, that resulted in learned taste aversions, was studied. Several days after familiarization with milk, rats were allowed to drink sucrose solution and were x-irradiated (50 R) four to 32 hr later. Subsequently, they were given a preference test between sucrose solution and milk. Two types of controls were used: irradiated controls were irradiated, but did not drink sucrose prior to irradiation; and sham controls drank sucrose but were placed under an unenergized x-ray unit. Irradiated controls ate chow prior to irradiation. In a subsequent preference test, those experimental rats irradiated 6.5 hr or less after sucrose consumption exhibited an aversion to sucrose relative to both types of controls. In a similar experiment, rats exposed to

50, 150, or 250 R seven hr after consuming sucrose solution developed greater aversion to sucrose solution with increasing radiation dose. (BBB)

43448 METABOLISM OF NUCLEIC ACIDS AND PROTEINS AND THE FORMATION OF CYTASTERS IN AMPHIBIAN EGGS TREATED WITH HEAVY WATER. **Van Assel, S.; Brachet, J. (Univ. Libre, Brussels). J. Embryol. Exp. Morphol., 19: 261-72 (Apr. 1968). (In French).**

Amphibian eggs (Pleurodeles and Xenopus) form cytasters, that are composed of astral fibers and probably centrioles, upon treatment with concentrated D_2O. A study of the importance of nucleic acid and protein synthesis for the formation of cytasters was undertaken; both precursors and inhibitors of these syntheses were used. It was found that D_2O completely inhibited synthesis of nuclear DNA. Hydroxyurea (an inhibitor of DNA synthesis) and x rays did not inhibit the appearance of the cytasters, which was clearly independent of nuclear DNA replication. Antinomycin D, a classical inhibitor of RNA synthesis, had no effect on cytaster formation. Eggs treated with D_2O incorporated ^{14}C-leucine in the nucleus as well as in the cytoplasm, including the cytasters. However, puromycin, which inhibits protein synthesis, had no effect on the formation of cytasters in Pleurodeles and Xenopus eggs. Another inhibitor of protein synthesis, cycloheximide, prevented the formation of cytasters in the eggs of Pleurodeles but not in those of Xenopus. Mercaptoethanol also blocked the appearance of cytasters in the eggs of Pleurodeles without affecting those of Xenopus. (BBB)

43449 ELECTRICAL ACTIVITY OF CEREBRAL CORTEX IN SEVERE COMBINED INJURY (RADIATION AND TRAUMATIC SHOCK). **Saleimenov, A. A. Tr. Kaz. Nauch.-Issled. Inst. Onkol. Radiol., 1: 375-9(1965). (In Russian).**

Dogs received 350 and 500 R of total-body radiation with 180-kV x rays. Within 60 to 90 min after irradiation, the locally anesthetized dogs underwent surgery in which both carotid arteries were exposed. Then, a cannula connected to a kymograph was inserted into the left carotid artery to trace arterial pressure; the right carotid artery was bound with ligature to determine the synocarotid reflex. The blood flow and respiration rate were recorded. At first, a light trauma was effected in irradiated control dogs by a limited number of body blows without producing traumatic shock. One hour later, each dog of this group received 195 heavy blows to a hind leg, with resulting traumatic shock. The trauma was also produced along with tests on Novocaine blocking injections and an induction current. The electroencephalograms indicated that during the incipient trauma in irradiated (350-R) dogs the electrical activity of cerebral cortex was stimulated and disappearance of α waves was evident, while spiked waves appeared with a 60-μV amplitude (frequency 18 to 20/sec). This corresponded to a 10 to 15 mm Hg drop in arterial pressure, also to a 35 to 42% decrease of synocarotid reflex from the initial level, and to increased pulse and respiration rates (110 and 60 respectively). Severe trauma was followed by shock in irradiated (500-R) dogs, blood clotting impairment, a 50 to 54% drop in arterial pressure (to 60 or 70 mm Hg), abolished synocarotid pressor reflex, decreased adrenocortical function, body temperature decrease of 1 to 1.5°C, and sluggish blood flow. Electroencephalograms showed considerable changes in electrical activity of the cerebral cortex: slow and irregular waves appeared, of which the most characteristic were those of 10 to 20 μV amplitude range (frequency 3 to 4/sec). (BBB)

43450 CARCINOGENIC EFFECT OF IRRADIATION: LOW DOSES OF RADIOACTIVE IODINE ON THE THYROID GLAND OF THE RAT AND MOUSE. **Lindsay, Stuart (Univ. of California, San Francisco); Nichols, C. W. Jr.; Chaikoff, I. L. Arch. Pathol., 85: 487-92(May 1968). (UCB-34-P-11-9).**

A comparison was made of the effects of small doses of ^{131}I injected intraperitoneally in 1076 rats (1 to 5 μCi) six weeks old and 440 mice (0.25 to 1.25 μCi) four weeks old. Thyroid adenomas were found 12 months later in 9% of rats injected with 5 μCi of ^{131}I and 24 months later in 12% of the rats. A single papillary carcinoma developed in a rat six months after injection of 1 μCi of ^{131}I. One atypical adenoma developed in a mouse 12 months after injection of 1.25 μCi of radioiodine. Since thyroid glands of both the rats and mice failed to show evidence of radiation injury or effects of thyrotropin (TSH), it was suggested that both benign and malignant thyroid neoplasms might be initiated in the rat and mouse by irradiation with ^{131}I and that the promoting factor of these neoplasms could be normal thyroid growth, rather than excessive TSH stimulation. (BBB)

43451 NERVE PENETRATION AND REGENERATION AFTER X-RAYED LIMBS OF TRITURUS VIRIDESCENS WERE COVERED WITH UNX-RAYED EPIDERMIS. **Rose, Florence C.; Rose, S. Meryl (Tulane Univ., Belle Chasse, La.). Growth, 31: 375-80 (Dec. 1967).**

Whether x irradiation blocked regeneration by interfering with the neural-epidermal junction was tested in three groups of limbs after amputation: normal limbs of adult *T. viridescens* after simple amputation, limbs irradiated with 2000-R, and irradiated limbs with a graft of normal skin from which epidermis had migrated over the distal wound of the stump. The limbs were fixed at intervals from the time of amputation to 34 days after amputation. Sections of the 83 nerve-stained normal limbs indicated that nerves had penetrated the epidermis by seven days after amputation and that all limbs fixed between seven and 34 days contained nerve fibers in the epidermis. In contrast, no nerve fibers were found in the epidermal wound covering of 76 of 82 irradiated stumps. Nerves lay close to the epidermis but fibers failed to enter it. No regeneration occurred in these irradiated limbs. In the remaining six cases a few fibers did penetrate the epidermis and small protuberances formed. In the 82 irradiated limbs which had received normal epidermis, nerve fibers from irradiated nerves did penetrate the unirradiated epidermis as early as eight days after amputation and endings were seen close to the epidermal cells. The irradiated limbs covered with normal epidermis that were allowed to develop regenerated all missing limb structures. Thus the neural-epidermal junction was not formed between irradiated epidermal and irradiated internal tissues and there was no regeneration. When that junction was formed between normal epidermal and irradiated internal cells both redifferentiated, grew and divided, and redifferentiated into the missing distal parts of the limb. It appeared that irradiation blocked limb regeneration by interfering with the establishment of a neural-epidermal junction. (BBB)

43452 INDUCTION OF TUMORS WITH COMBINED TREATMENT OF HEAD X IRRADIATION AND RADIOIODINE (^{131}I) IN RATS WITH SPECIAL REFERENCE TO THE CHARACTERIZATION OF PITUITARY TUMORS AND LEUKEMIAS. **Ito, Akihiro (Hiroshima Univ.). Hiroshima Daigaku Igaku Zasshi, 15: 763-808(Nov.-Dec. 1967). (In Japanese).**

Incidence of tumors was studied in five groups of irradiated rats. Group I received 800-R doses of x irradiation of the head plus a 300-μCi dose of ^{131}I injected intraperitoneally; Group II, 300 μCi of ^{131}I only; Group III, 800-R head irradiation plus 20 μCi of ^{131}I; and Group IV, 20 μCi of ^{131}I only. Out of a total of 168 rats, eight developed leukemia; in six it was of the myeloid type. The incidence of pituitary tumors in each group was as follows. Group I, male 88%, female 100%; Group II, male 63%, female 61%; Group III, male 27%, female 51%; Group IV male 0%, female 43%. The radiothyroidectomized rats bearing β-cell pituitary tumors showed hypofunction of pituitary target organs, such as hypothyroidism, atrophy of adrenal cortex, gonads, and parenchymatous organs. The mammary gland was also atrophic. On the contrary, α-cell type of pituitary tumors, which developed in Group III and Group IV, had no effect on thyroid function, but brought about the hyperplasia of the mammary gland with acceleration of milk secretion. Among the rats that received localized head-neck x irradiation, various other types of malignant neoplasms developed within the irradiation area. Five out of nine such tumors were osteogenic sarcomas which were transplantable in adult syngenic rats. These malignant lesions were never observed in nonirradiated areas not among nonirradiated controls. Radiation cataract began to develop in all localized x-irradiated rats at about three months after irradiation, and with time the opacities gradually enlarged and coalesced until eventually the lenses were entirely opacified. (BBB)

43453 RESPONSE OF TESTIS AND COMB OF THE RADIOTHYROIDECTOMIZED CHICK TO PMS. **Snedecor, James S. (Univ. of Massachusetts, Amherst). Poultry Sci., 47: 148-51 (Jan. 1968).**

Effects of destruction of the thyroid of chicks with ^{131}I on body wt, wt of testis, comb, bursa, and liver, length of the foot, and liver glycogen were studied, as well as the effect on these changes of treatment with pregnant mare serum (PMS) gonadotropin. Radiothyroidectomy (RT_x) was done at age five days by the intraperitoneal injection of 1.7 mCi ^{131}I/100 g body wt. When the chicks were 27 days old, PMS injections were started (injections subcutaneously once a day for five days). Radiothyroidectomy resulted in significantly different values from the control values for each of the above-mentioned parameters. RT_x resulted in lower body wt, as well as lower absolute and relative wt for testis, comb, and bursa. Absolute and relative liver wt were increased, and liver glycogen concentration was higher in the RT_x chicks. In the RT_x chicks, PMS caused a significant increase in the weight of the testes (74%), but the increase in comb weight (30%) was not significant. The gonadotropin did not significantly affect any other parameters in the hypothyroid chicks, whether considered on an absolute wt basis or a % body wt basis. The uptake of the test dose of ^{131}I in RT_x chicks gave counts of 0.5% or less of the control thyroid uptake. After PMS injections the lack of a significant comb response suggested that the Leydig cells in the testes of hypothyroid chicks did not respond to gonadotropin. (BBB)

43454 LASER RADIATION AND THE EYE. Liska, M. (Technical Univ., Brno); Riebel, O.; Vanysek, J. Jemma Mech. Opt., 12: 341-4(Nov. 1967). (In Czech).

The size and the structure of photocoagulation lesions are the basis for the introduction of the concept of dose values characteristic of the physiological action of the energy of light reaching the background tissues of the eye. The exponential energy distribution in the laser beam accounts for the substantial portion of the light energy that is transferred in a small space angle. On the basis of this factor the irradiation of the human eye is a function of the distance of the eye from the laser. (JPRS)

43455 EFFECT OF X IRRADIATION ON MORPHOLOGICAL AND PROLIFERATIVE CHANGES OF NEUROGLIA DURING THE RETROGRADE REACTION AFTER CRUSHING THE HYPOGLOSSAL NERVE. Sjoestrand, Johan (Univ. of Gothenburg, Sweden). Exp. Neurol., 20: 384-93(Mar. 1968).

The effect of x irradiation on DNA synthesis by neuroglia cells and evaluation of the effect of irradiation on the regenerating hypoglossal nerve were reported. [This regeneration process is characterized by a pronounced glial proliferation during the first week after nerve crushing and conspicuous changes in morphology of neuroglia cells during early postoperative months. The regenerating hypoglossal nucleus of the rabbit, with its reproducible pattern of glial reaction, was used to determine the relation between x-ray dose and irradiation effects on different cell populations.] Fifty 11- to 13-week-old female albino rabbits were irradiated over the brain stem, using 200-KV x rays with single surface doses of 100 to 3000 R; actual dose given to the hypoglossal nerve was estimated to be about 90% of the surface dose. The right hypoglossal nerve was crushed at the point where it transversed the digastric muscle, and the animals were killed from the third to the 28th day later. The effect of x irradiation on proliferating neuroglia and endothelial cells was demonstrated by ^{3}H-thymidine autoradiography in the hypoglossal nerve. Changes in morphology were studied with metallic impregnation and histochemical methods. Doses of 300 R or more produced temporarily a total inhibition of DNA synthesis and of mitotic activity in the proliferating cell population during the following two days in the regenerating hypoglossal nerve; 100 R led to decrease in the number of DNA-synthesizing cells of about 70% from 24 to 48 hr after irradiation. A single dose of 300 R or two repeated doses of 600 R resulted in marked reduction of microglial hyperplasia and hypertrophy, while no changes were observable in the retrograde reaction of nerve cells and astrocytes. (BBB)

43456 A COMPARISON OF THE KILLING OF CULTURED MAMMALIAN CELLS INDUCED BY DECAY OF INCORPORATED TRITIATED MOLECULES AT -196°C. Burki, H. John (Univ. of California, Berkeley); Okada, S. Biophys. J., 8: 445-56(Apr. 1968).

The killing efficiency of tritium disintegrations in frozen mammalian cells labeled with tritium-labeled uridine, histidine, or lysine was compared with the killing efficiency of incorporated tritium-labeled thymidine. Distribution of tritium in the cells was determined by chemical fractionation and autoradiography. Of all tritium disintegrations, by far the most effective were those occurring in DNA molecules within frozen cells, where incorporated tritium had a killing efficiency of 0.006. In cells incubated with tritium-labeled uridine for 10 min to label nuclear RNA, the killing efficiency was 0.0015. After pulse labeling with tritium-labeled uridine and growth in nonradioactive media for 100 hr before freezing to incorporate tritium into cytoplasmic RNA, the killing efficiency was reduced to 0.0010. Thus, decay of tritium in nuclear RNA was more effective than that in cytoplasmic RNA. When the cells were labeled with tritium-labeled histidine or lysine for 30 min, tritium atoms were found mainly in the acid-soluble rather than in the protein fraction and the killing efficiency in each case was 0.0007. These suicide experiments indicated that the killing efficiency of tritium disintegrations depended on where tritium was located within the cells. Tritium disintegrations in the nucleus were more effective in killing the cell than those in cytoplasm. Tritium disintegrations on DNA in the nucleus were more effective in killing the cell than those on nuclear RNA. (BBB)

43457 TOTAL-BODY IRRADIATION IN THE HUMAN BEING. Andrews, Gould A. (Oak Ridge Inst. of Nuclear Studies, Tenn.). Excerpta Med. Int. Congr. Ser., No. 105, 1583-9([1966]).

Data concerning the effects of whole-body radiation on man are based on observations of patients given radiotherapy for malignant disease and a group of eight healthy men exposed in a radiation accident. Response to extremely high doses is characterized by the neurological syndrome resulting in death within a few hours; at somewhat lower doses, the gastrointestinal disturbance predominates with death occurring within two weeks; at lower doses hematological disorders predominate and bone marrow depression may result in death or spontaneous recovery may begin about the sixth week. Hematologic changes and typical syndromes are described, and graphs are presented to show effects of radiation dose on hematologic events. Treatment of radiation damage includes infusion of thrombocytes, protection against infection, administration of antibiotics, and bone marrow grafts. (H.L.W.)

43458 THEORETICAL "ISO-SURVIVAL" FORMULAE FOR FRACTIONATED RADIATION THERAPY. Cohen, Lionel (General Hospital, Johannesburg). Brit. J. Radiol., 41: 522-8(July 1968).

A formula describing the cellular response in x-irradiated tissues and tumors was found to require at least three exponential components (for irreversible single-hit damage, multi-target inactivation with early repair, and a cellular repopulation factor) in order to conform with observed dose-time relationships. On this basis a computer program was designed to determine and compare the proportion of cells surviving various standard fractionation procedures producing identical skin reactions and similar tumor responses. Parameters were adjusted sequentially to minimize variance, thus deriving best-fitting estimates of all the relevant factors. Results showed that the mean cellular lethal dose D_0 was about 100 rads in both skin and tumor (no anoxic component could be resolved). The proportion of radiation damage due to the irreversible component was apparently greater in the tumor (nearly half) than in normal skin (about one-third). Similarly, extrapolation numbers were high (26 to 30) in the normal skin cells but smaller in the tumor. Mean cellular regeneration times were between three and five days for irradiated skin, but apparently slower, certainly over ten days, in the tumor. The computed surviving fraction was about 10^{-8} in the cured tumor, compatible with an estimated viable tumor-cell population of the order of 10^8 cm^{-3}. Cellular survival was about 10^{-5} in the larger skin fields but approached 10^{-7} in smaller fields, a difference sufficient to explain the dependence of tolerance dosage on field-size, although the possibility of a correlated change in D_0 could not be excluded. Applying appropriate parameters to this model, optimal values could be assigned for over-all treatment time, number of fractions, and dose-per-fraction, thus defining a technique promising the maximum likelihood of uncomplicated cure. (auth)

43459 FRACTIONATION PROCEDURES IN RADIATION THERAPY: A COMPUTERISED APPROACH TO EVALUATION. Cohen, Lionel; Scott, Mary Jean (General Hospital, Johannesburg). Brit. J. Radiol., 41: 529-33(July 1968).

The effects on the cell populations of normal tissues (skin) and tumors (epidermoid cancer), of various fractionation schemes for radiation therapy, were computed on the basis of a three-component model. The relatively minor effects attributable to induced mitotic synchrony, accumulation of irreparable injury, and the presence of an anoxic component were neglected. Iso-effect curves were generated for various intervals between fractions, ranging from 0.125 day to 32 days, by specifying the lowest permissible fraction of normal-cell survival, for three field sizes. The iso-effect curve for daily treatment is in good agreement with observed tolerance doses. Iso-effect curves for intervals of 0.25 day or less agree closely with clinical results for continuous irradiation. The model used is probably not valid for intervals of more than four days, for reasons that are discussed. The results can be interpreted in terms of the relative efficacies of various fractionation schemes, so that optimal schemes may be selected. (auth)

43460 GROWTH KINETICS OF SOLID LYMPHOSARCOMA NKLy AFTER THE ACTION OF IONIZING RADIATION IN DIFFERENT DOSES. Pelevina, I. I.; Afanas'ev, G. G.; Lipchina, L. P.; Emanuel, N. M. (Inst. of Chemical Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Biol., No. 1, 99-108(Jan.-Feb. 1968). (In Russian).

Growth kinetics of the solid lymphosarcoma NKLy were not affected by different doses of ionizing radiation and are described by the equation $D(t) = at^b$. The regression coefficient characterizing the tumor growth rate is significantly reduced by radiation doses of 1500 to 2000 R. Radiosensitivity of tumors was indicated by metastases and diameter of tumors. (H.L.W.)

43461 RADIATION-INDUCED URINARY EXCRETION OF DEOXYCYTIDINE BY RATS AND HUMANS. Chen, I-Wen; Kereiakes, James G.; Friedman, Ben I.; Saenger, Eugene L. (Univ. of Cincinnati). Radiology, 91: 343-8(Aug. 1968).

Excretions of deoxycytidine in the urines of rats and cancer patients following exposure to x or γ radiation were studied by the use of the thiobarbituric acid colorimetric analysis developed in our laboratory. Urinary excretion of deoxycytidine by the rat increased linearly with γ radiation doses up to 200 R. Approximately, a sixfold increase from an average preirradiation value of 0.7 mg per 24-hour urine was attained at 200 R. Radiation also caused temporary accumulation of deoxycytidine in rat blood. Deoxycytidine concentration reached the maximum about nine hours after irradiation and six hours prior to the peak excretion of deoxycytidine into urine. Urinary excretion of deoxycytidine was much lower in man. Approximately a twofold increase from an average preirradiation value of 7 μg per 24-hour urine was observed in 4 out of 5 cancer patients receiving 178 to 300 rads of local, partial, or total-body γ irradiation. Deoxycytidinuria is not as sensitive a biological indicator of radiation dose in man as in a rat. (auth)

43462 ACTION OF X RAYS ON THE OSMOTIC PRESSURE AND THE pH OF THE HOMOLYMPH OF GALLERIA MELLONELLA L (LEPIDOPTERA INSECT). Mestres, Gerald; Laviolette, Pierre (Institut National des Sciences Appliquees, Villeurbanne, France). Compt. Rend., Ser. D, 266: 2093-6(May 13, 1968). (In French).

Larvae of Galleria mellonella L. were exposed to fixed doses of x rays and hemolymph samples were taken after delays of 1 to 4 to 5 days. The effect of the sampling delay had great effect on the osmotic pressure (pO) regardless of the dose. A decrease in pO was observed on the first and second days after irradiation. At the end of 4 to 5 days, regardless of the dose used, the pO returned to normal. This implied the existence of a relatively rapid and efficient control. For the pH, no coherent action appeared; only some rare points presented characteristic differences from the controls. (tr-auth)

43463 RADIOACTIVE JEWELRY AS CAUSE OF CUTANEOUS TUMOR. Gerwig, Theodore; Winer, Marvin N. J. Amer. Med. Ass., 205: 595-6(Aug. 19, 1968).

A case study of the development of a squamous cell carcinoma that was caused by the wearing of radioactive jewelry and that necessitated amputation of the ring finger is presented. The radioactivity was confined to an insert of gold placed in a cameo ring. The dose rate was a function of position; the maximum dose possible was about 700 mrads/hr at the center of the insert. The β particle source was gold from radon seeds (lead-210). (B.S.L.)

43464 INHERITED STERILITY IN PROGENY OF IRRADIATED MALE CABBAGE LOOPERS. North, David T.; Holt, Gerald (Dept. of Agriculture, Fargo, N. Dak.). J. Econ. Entomol., 61: 928-31(Aug. 1968).

When normal female cabbage loopers, Trichoplusia ni (Hübner), were mated with adult males that had received 20 krad of gamma radiation, 15 to 20% of their eggs hatched. The progeny of this cross were sterile when they mated with normal moths of the opposite sex. Thus, the F_1 progeny are more sterile than their irradiated male parents. Irradiation of the parental and F_1 generations with 10 krad each did not cause more or less sterility in the F_1 generation than 20 krad of irradiation to the P_1 generation. Apparently the inherited sterility in the F_1 generation is caused by the induction of large numbers of reciprocal chromosome translocations. The abnormally high frequency of induced translocations was probably the result of a unique chromosomal structural feature of Lepidoptera; namely, diffuse centromeres. The complete sterility obtained in the F_1 generation when only a substerilizing dose of radiation was given to the male parent may prove of added value in using the sterile-male technique for eradication of Lepidoptera. Reducing the amount of radiation administered to an individual to effect sterility could well improve the competitiveness of the sterile male, a limiting factor thus far in the sterile-male release of Lepidoptera. (auth)

43465 LYMPHOGRAPHIC PICTURES OF LYMPHATIC NODES AFTER X-RAY IRRADIATION. Malska-Waniewska, Izabella; Studencki, Eugeniusz; Naganski, Tadeusz. Nowotwory, 18: 161-8(Apr.-June 1968). (In Polish).

Extremital lymphography (Lipiodol Ultra-fluid) was performed in order to learn whether postirradiation in inguinal lymph nodes could be detected in the lymphographic picture and whether they posed an obstacle for flow of lymph. The examinations were made in 14 women with cervix uteri carcinoma who were irradiated under conventional conditions. It was assumed that in these patients the postirradiation lesions in inguinal nodes were not masked with eventual metastases. In all cases the alterations consisted of a decrease in number and size of nodes, obliteration of the internal structure, and in masked clearness of the external contours. Time (5 months to 15 years) had no effect on these alterations. No impairment of the flow of the contrast oil was observed in altered nodes in any of the patients. It was concluded that contrary to neoplastic metastases the postirradiation alterations in nodes did not block the flow of lymph. (auth)

43466 SENSITIVITY OF VARIOUS STAGES OF THE GRAIN MITE (ACARUS SIRO L.) TO GAMMA RADIATION. Dabrowski, Zbigniew T. Rocz. Nauk Roln., Ser. A, 93: 613-22(1968). (In Polish).

The effect of γ radiation on the various stages (resting and motile) of the grain mite (Acarus siro L.) was studied. The larvae, nymphs and adult stages of the mite were treated with doses from 1×10^4 to 1×10^5 R. Several stages showed different sensitivity to the same dose of ionizing radiation. The most resistant were resting larvae and nymphs. The effects on the immobile larvae, protonymphs and tritonymphs were similar. After exposure to 8×10^4 R about 30% continued to develop. The radiation significantly reduced the number of eggs laid by adults that developed from irradiated resting larvae, protonymphs, and tritonymphs. Exposure to 1.8×10^4 R was lethal to adults during 10 days, but irradiated mites laid eggs out of which some larvae hatched and developed. In irradiated adults placed in 50% relative humidity during 1 hour mortality suddenly increased. At 1×10^4 R, 100% mortality by 5 days after treatment was noted. A change of humidity did not distinctly influence the mortality of irradiated resting larvae. (auth)

43467 ORIGIN OF ELASTIC VIBRATIONS IN BIOLOGICAL MEDIUMS UNDER THE INFLUENCE OF RUBY LASER RADIATION. Gorodetskii, A. A.; Evdokimov, I. R.; Kolesnik, V. M.; Shevko, A. N. (Inst. of Physiology, Kiev). Fiziol. Zh., Akad. Nauk Ukr. RSR, 13: 230-3(Mar.-Apr. 1967). (In Ukrainian).

Elastic waves induced by pulsed radiation from a ruby laser were investigated in solid and liquid substances (aluminum, iron, colored and clear glass, various colored liquids) as well as in biological materials (skin, muscles, liver, spleen, heart, kidneys, and lungs of cats and rats). The device used in the experiments produced oscillations recorded by an electrical transducer and by an energy laser 6.5 mm in dia with a 5m/sec 1 J pulse and a ruby rod 80 mm long. The results indicated that the pulsed optical quantum generator radiation induced elastic waves with amplitudes determined by the absorption coefficients of the surface of the object being investigated. The elastic oscillations were well distributed in the tissues of animals. (R.V.J.)

43468 PATHOMORPHOLOGICAL CHANGES IN HEART, LUNGS, SPLEEN, AND CEREBRAL CORTEX OF RATS IRRADIATED BY FAST NEUTRONS. Gerasimova, T. B. (Inst. of Biology, Kiev). Fiziol. Zh., Akad. Nauk Ukr. RSR, 13: 266-71 (Mar.-Apr. 1967). (In Ukrainian).

Radioinduced pathological changes in the heart, lungs, spleen and cerebral cortex were studied. Ninety-four male white rats were exposed to a single 400 rad dose of fast neutrons from a WWR-M reactor. The experiments revealed various degrees of degeneration and dystrophy in the tissues and organs. Observations over a long period of time revealed atrophy, necrosis, and incomplete recovery from radiation damage. A year later a group of rats developed pneumonia, edema, and bronchiolectatic abscesses. (R.V.J.)

43469 INVESTIGATION OF $^{14}CO_2$ EXHALATION AFTER INTRAGASTRIC ADMINISTRATION OF ^{14}C-GLYCERYL TRIOLEATE AND ^{14}C-OLEIC ACID TO RATS AFTER WHOLE-BODY X IRRADIATION. Glaubitt, D.; Wulff, K.; Ulrich, I. (Univ., Hamburg). Fortschr. Geb. Roentgenstr. Nuklearmed., 108: 790-4(June 1968). (In German).

Whole-body x irradiation of 600 to 800 R of male Wistar rats lead to a reduction in $^{14}CO_2$ production following intragastric administration of ^{14}C-triolein and an increase after ^{14}C-oleic acid. Whole-body irradiation produced a reduction in carbon dioxide production. Specific radioactivity in the exhaled air of irradiated rats fell after the administration of ^{14}C-triolein and increased after ^{14}C-oleic acid. (auth)

43470 EFFECTS OF X RADIATION ON THE LIFE SPAN OF VARIOUS STRAINS OF ARTEMIA SALINA LEACH. Metalli, P.; Ballardin, E. (CNEN, Rome). Boll. Zool., 32: 587-602 (1965). (In Italian). (RT/BIO-(66)26).

Ionizing radiations induce a definite life span shortening in most organisms. Many difficult problems arise, both of experimental and interpretative nature, when this effect is studied on mammals. Therefore it would appear that simpler biological materials could offer an easier and perhaps more useful approach, especially if general theories are to be tested. Artemia salina Leach, (the brine shrimp, Crustacea, Phyllopoda) was used in the present investigation in the attempt of collecting data bearing on the subject of the theory of somatic mutations. This peculiar biological material has been chosen because of its different diploid and tetraploid genotypes naturally found in salterns and salt lakes, the availability of a standard laboratory culture technique under controlled environmental condition, and the fact that the tetraploid condition is associated with a greater radioresistance for both somatic short-term effects and genetic effects. The dose-effect curve was determined for a tetraploid parthenogenetic strain, considered as standard on account of its high genetic homogeneity; other four strains have been compared to it. The data allow the following conclusions: the life span shortening induced by x rays, as estimated by the median survival of irradiated groups and compared with the median survival of control groups, is an exponential function of the dose, within the dose range of 10–50 Krad; the curve shows no appreciable shoulder, or threshold, and therefore the radiation damage responsible for this effect is strictly cumulative and irreparable; diploid and tetraploid females, both bisexual and parthenogenetic, and tetraploid bisexual males, all follow the same dose-effect relationship, therefore the degree of ploidy by itself has no effect on the responses to radiation. This argues against the accumulation of somatic mutations as responsible for the life shortening effect. Diploid males are more resistant and show an appreciable shoulder; by dose-fractionation experiments it has been confirmed that in the tetraploid parthenogenetic strain, the damage is indeed not repairable. (auth)

43471 EFFECT OF CHRONIC EXPOSURE TO PULSED AND NONPULSED 10-cm WAVES ON THE CONDITIONED-REFLEX ACTIVITY OF WHITE RATS. **Lobanova, E. A. (Inst. of Industrial Hygiene and Occupational Diseases, Moscow). Gig. Tr. Prof. Zabol., No. 10, 7-12(1966). (In Russian).**

Most dosimeters used for the measurement of microwave fields are capable only of measuring the average field power density. Here, the power of a pulse (assuming pulsed generation) is overlooked. The power of a typical microwave pulse exceeds the average measurable field power density by 100 to 1000. This problem is important relative to the biological effects of microwaves. Pulsed and non-pulsed microwaves have a virtually identical biological effect, except for initial reactions to the two regimes. In view of the demonstrated high sensitivity of the CNS to this factor, a well-controlled, reflex-oriented experiment was conducted on rats exposed to pulsed and nonpulsed 10-cm waves. The field power density was 40 mw/cm^2. The duration of exposure was 15 min, and experimental animals were irradiated a total of 99 times over a period of 4 months. Fourteen rats were divided into three groups: group exposed to pulsed microwaves; group exposed to nonpulsed microwaves; paired controls exposed to identical experimental conditions and studied at the same time as experimental animals. The Kotlyarevskiy method of developing conditioned reflexes was employed. The positive stimulus was a rather strong 600-cps tone and green light (a rather weak stimulus). Differentiation to a 300 cps tone was developed. It was found that shifts in reflex activity characterized by disinhibition and a depression of reflex activity were identical as a result of exposure to pulsed and nonpulsed microwaves. However, the effects of pulsed microwaves were more pronounced and occurred earlier (during the 1st to 19th exposure). On the other hand, reflex shifts in animals exposed to nonpulsed radiation occurred considerably later (during the 81st to 99th exposures). The cause of all observed shifts was concluded to be a weakening of basic neural processes caused by microwaves. (ATD)

43472 RADIATION HAZARDS TO THE HUMAN FETUS IN PRESENT-DAY SOCIETY: SHOULD A PREGNANT WOMAN BE SUBJECTED TO A DIAGNOSTIC X-RAY PROCEDURE. **Schwarz, Gerhart S. (New York Medical Coll., N. Y.). Bull. N. Y. Acad. Med., 44: 388-99(Apr. 1968).**

Evidence relating to possible in utero irradiation sequelae is assessed. The first rule of prevention should be avoidance of diagnostic x-ray procedures other than radiography of the chest during pregnancy unless they are absolutely necessary. Usually the radiographic study can wait until after delivery. Abdominal examinations on women of reproductive age should be confined to the first 2 weeks after the onset of menstruation. If an examination is necessary during pregnancy, it should be conducted with the minimum possible exposure by means of high-speed screens, collimators, filters, high-speed films, low-ratio grids, long target-film distances, lead shields over the fetus when applicable, and by an experienced technician who will not need to repeat a procedure because the first film obtained was inadequate. The data showed that the percentage of x-ray pelvimetries performed on pregnant patients in the Sloane Hospital for Women between the years 1950 and 1963 had decreased from 15 to 5% and that the neonatal mortality had remained constant over the years despite the decrease in the number of x-ray procedures. (BBB)

43473 FACTORS INFLUENCING HEMATOPOIETIC SPLEEN COLONY FORMATION IN IRRADIATED MICE. IV. THE EFFECT OF ERYTHROPOIETIC STIMULI. **Marsh, John C. (Yale Univ., New Haven); Boggs, Dane R.; Chervenick, Paul A.; Cartwright, George E.; Wintrobe, Maxwell M. J. Cell. Physiol., 71: 65-76(Feb. 1968).**

The effect of various types of erythropoietic stimuli (bleeding and injection of erythropoietin, testosterone, Co, or Co and testosterone) upon endogenous colony formation, upon the number of transplantable colony forming cells, and upon survival following irradiation was studied. Their effects were assessed by the number of endogenous spleen colonies in irradiated mice and the number of transplantable colony-forming cells in the spleen and marrow of unirradiated mice. Bleeding was the most effective stimulus. Bleeding before irradiation resulted in a 30-fold increase in endogenous spleen colonies and in increases in spleen weight, spleen ^{59}Fe and ^{125}I-iododeoxyuridine uptake, and volume of packed red cells 10 days after irradiation. Bleeding unirradiated mice produced a 10-fold increase in the number of transplantable colony-forming cells in the spleen and a slight decrease in the total number in the humerus. Bleeding before irradiation resulted in a significant reduction in 30-day postirradiation deaths, an effect abolished by splenectomy. Plasma from bled mice induced an increase in endogenous colonies when injected before irradiation into normal mice. Erythropoietin, testosterone, or testosterone plus Co induced effects qualitatively similar to those of bleeding, but less effective quantitatively. Postirradiation stimulation in normal mice proved ineffective. Erythropoietin increased colony numbers and spleen iron uptake when given after irradiation to hypertransfused mice. Evidently the colony-forming cell and the erythropoietin-sensitive cell are not separate entities. (BBB)

43474 STUDIES ON THE PROBLEM OF MODIFYING HUMAN ISOAGGLUTININS BY ADRENAL STEROIDS, X RAYS, AND ANTI-INFLAMMATORY DRUGS. **Frenger, W.; Cheikh-Ali, H. (Univ., Erlangen-Nuremberg, Ger.). Z. Immunitaetsforsch. Allergie Klin. Immunol., 132: 295-301(1967). (In German).**

After treatment of 56 patients who had malignant tumors with 2000 to 7000 R of x irradiation there were only small changes in the isoagglutinin concentrations, when measured five or six weeks after treatment. The small differences observed in the irradiated patients were less than the preirradiation average, but they were not statistically significant. The authors do not specify the types of tumors that the patients had, but there were only a few abdominal tumors. The results reported are opposite to those reported for animal studies where definite increases in antibody formation were reported after administration of sublethal doses of whole-body irradiation. However, in clinical studies like that reported here where x irradiation is given locally, few changes can be observed in the agglutinin titer. (BBB)

Radiation Effects on Plants

Refer also to abstracts 43205, 43207, 43219, 43227, 43237, 43262, 43264, 43276, 43279, 43289–43293, 43300, and 43313.

43475 (COO-1432-4) EFFECT OF RNA FROM DIFFERENT STAGES OF THE MITOTIC CYCLE UPON CELL GROWTH AND MITOSIS IN A SLIME-MOLD WITH SYNCHRONOUS MITOSIS. **Progress Report, January 1, 1967–March 31, 1968. Guttes, Edmund W. (Loyola Univ., Chicago, Ill.). May 10, 1968. Contract AT(11-1)-1432. 19p. Dep. CFSTI.**

Since no positive effect of RNA and DNA preparations on UV-irradiated plasmodia was found, the role of macromolecular syntheses in the first and in several subsequent postirradiation mitoses was studied. The sensitivity toward actinomycin-C, used as an inhibitor of RNA synthesis, declined rapidly after irradiation, e.g., when applied several hours after irradiation, the effect of actinomycin was very low compared to that in unirradiated control pieces. The results of a study of the effect of actinomycin upon the rates of incorporation of ^{3}H-uridine in irradiated plasmodia did not suggest that the reduced sensitivity of irradiated plasmodia was due to a decreased uptake of the drug. Uptake of ^{3}H-actinomycin by irradiated plasmodia was not considerably lower than that by unirradiated controls. Transfer of irradiated plasmodia from growth medium to non-nutrient balanced salt solution caused only a slight delay of mitosis as compared to that caused by similar treatment of controls. Inhibition of protein synthesis by actidione caused a strong inhibition of mitosis, as in controls. FUDR had an inhibitory effect upon mitosis in irradiated plasmodia similar to that found in non-irradiated controls. Because of the short duration of the two mitotic cycles following the first, delayed, postirradiation mitosis, growth was determined in terms of DNA, RNA, and proteins, of irradiated plasmodia through two mitotic cycles following the first postirradiation mitosis. The amount of DNA per plasmodium decreased between irradiation and first postirradiation mitosis. DNA increased only slightly between first and second postirradiation mitosis. After the second postirradiation mitosis, DNA increased rapidly. RNA continued to increase slowly after irradiation and, at the first, delayed, postirradiation prophase, the plasmodia contained more total RNA than the non-irradiated controls at the corresponding mitosis, although the level of RNA at the first postirradiation phosphase was considerably below that in control plasmodia at the same time. The level of RNA increased after the first postirradiation mitosis, but the relative increases during the two mitotic cycles succeeding the first postirradiation mitosis were considerably lower than the increases during the corresponding mitotic cycles in controls. The competence for mitosis of irradiated nuclei was investigated by transplantation into non-irradiated hosts. When transplanted approximately five hrs before the expected mitosis of the host nuclei, the implanted nuclei were able to undergo mitosis in synchrony with the nuclei of the host. Thus, lack of structural competence of the irradiated nuclei for participating in mitosis would not seem to be the reason for the failure to discover a positive effect of RNA preparations upon mitosis in irradiated plasmodia. The above results, showing that the UV-delayed mitosis exhibited a loss of sensitivity toward starvation and treatment with actinomycin, are in agreement with the finding that supplementation of irradiated plasmodia with RNA preparations had no beneficial effect upon mitosis. We are at present studying in more detail the role of macromolecular syntheses in the regulation of mitosis in irradiated plasmodia. (auth)

43476 (PRNC-61) THE RAIN FOREST PROJECT ANNUAL REPORT FY, 1965. (Puerto Rico Nuclear Center, Rio Piedras). Mar. 1, 1965. Contract AT(40-1)-1833. 220p. Dep. CFSTI.

A year of pre-irradiation measurements, construction and installation of the ^{137}Cs γ source (10,000 Curies), and preparations of the area ended January 19, 1965 with the start of 90 days irradiation. An account is given of the measurements taken in the various phases of work by resident staff and visiting participants. Some scientific results are included. The annual pattern of biological processes involves some properties that are remarkably constant and some other patterns that have definite seasonal patterns. (auth)

43477 RADIOBIOLOGICAL STUDIES OF CEREALS. II. DIFFERENCE IN RADIOSENSITIVITY FOR EQUAL NUCLEAR VOLUME AND DNA CONTENT. von Wangenheim, K.-H.; Walther, F. (Kernforschungsanlage, Juelich, Ger.). Radiat. Bot., 8: 251-8 (June 1968). (In German).

Feulgen photometric measurements on dormant nuclei and defined stages of mitosis, as well as measurements of volume, show that two winter wheats, though characterized by an extreme difference in radiosensitivity, differ neither as to the DNA content per nucleus nor as to their nuclear volume. Consequently, the difference in radiosensitivity must be due to other causes. A third species, of medium radiosensitivity, was found to have nuclei of higher DNA values (3%) and smaller volumes (3.7–7%). Accordingly, there is no immediate correlation between nuclear volume and DNA content. Therefore, predictions of radiosensitivity based only on the determination of DNA content and nuclear volume are only possible within certain limits. The nuclei of the apical meristem of the above-mentioned three species are about twice as large as those of the second leaf; there is, however, no difference in DNA content. Slight intraspecific differences in DNA measurements ascertained by Feulgen-photometry are supposed to be due to the method used. Most of the nuclei of the apical meristem and of the young leaf primordia in the dormant embryos are to be found in G_1 or the early S-stage. (auth) (UK)

43478 EFFECTS OF BRIEF WITHHOLDING OF ESSENTIAL ELEMENTS ON RADIOSENSITIVITY OF SUNFLOWER PLANTS. Wiecek, C. S.; Skok, J. (Northern Illinois Univ., DeKalb). Radiat. Bot., 8: 245-50(June 1968).

Seven-day-old sunflower seedlings (*Helianthus annuus* L., var. Mammoth Russian) were placed in solutions deficient in various essential elements for a 3-day period, x-irradiated with 1 kR, and then immediately transferred to a complete nutrient solution for a 36-day growth period. Plant measurements and visual radiation effects were used to assess radiation sensitivity. Plants subjected to a 3-day withholding of potassium, calcium, all nutrients or all macronutrients exhibited a marked increased resistance to damage by radiation compared to plants irradiated without any withholding prior to irradiation. Withholding nitrogen, phosphorus and iron had only a slight protective effect, while withholding sulfur and magnesium showed no observable protective effect. It is concluded that the brief exclusion of certain elements reduces growth rate and cellular activity quite promptly and thus renders young tissues more radioresistant, while the withholding of other elements fails to do so. These responses serve to demonstrate the relative rapidity of the onset of physiological effects brought about by the absence of a specific nutrient element. (auth) (UK)

43479 COMBINED EFFECTS OF STREPTOMYCIN AND X RADIATION ON THE TURNING GREEN OF GERMINATING WHEAT. Aivazyan, S. A.; Babayan, V. O. Biol. Zh. Arm., 21: 72-5(Feb. 1968). (In Russian).

The treatment of wheat seed with streptomycin caused albinism of the plants, the degree of the effect increasing proportionally with the increasing doses of antibiotic and duration. The irradiation of seeds, previously treated with streptomycin, plays a protective role against albinism. The degree of protection depends on the irradiation dose, antibiotic concentration, and antibiotic exposure. During post-irradiation treatment of the seeds with antibiotic, a protective effect of the radiation is limited and appears only at 20,000 R. (tr-auth)

43480 EFFECTS OF ULTRAVIOLET LIGHT ON MITOSIS IN PHYSARUM POLYCEPHALUM. Devi, Vimala R.; Guttes, E.; Guttes, Sophie (Loyola Univ., Chicago). Contract AT(11-1)-1432. Exp. Cell Res., 50: 589-98(June 1968). (COO-1432-3).

Plasmodia of the slime mold, *Physarum polycephalum*, were irradiated with uv light at different times in the mitotic cycle. Mitosis was delayed most if irradiation took place during the preceding mitosis or during early interphase (S-phase). From then on the sensitivity decreased gradually to almost zero at early prophase when irradiated with 2900 ergs/mm^2. With a dose of 14,500 ergs/mm^2, the sensitivity remained at an approximately constant level during the latter half of the intermitotic period. Irradiation with 14,500 ergs/mm^2 during early prophase, as late as 13 min before metaphase, caused reversion to interphase and approximately the same mitotic delay as irradiation at other times during the latter part of the intermitotic period. The mitotic cycles following the first postirradiation mitosis were shorter than the corresponding mitotic cycles of unirradiated control halves. At the first and second postirradiation mitosis the RNA/DNA and the protein/DNA ratios were above the levels measured for the corresponding mitoses in the control halves. After the second postirradiation mitosis these values gradually approached the levels found in the control halves. (auth)

43481 EFFECT OF SPACE FLIGHT ON THE SPUTNIK COSMOS-110 ON THE MICROSPORES OF TRADESCANTIA PALUDOSA. Delone, N. L.; Trusova, A. S.; Morozova, E. M.; Antinov, V. V.; Parfenov, G. P. Kosm. Issled., 6: 299-303 (Mar.-Apr. 1968). (In Russian).

For the first time a whole plant was placed on a sputnik. After flight no signs of depression were observed. A cytological analysis showed three types of changes: chromosome change-over, break-down in the mitosis mechanism, and gigantism of the cells. (tr-auth)

43482 SENSITIVITY OF STORED MELON FRUIT FUNGI TO GAMMA IRRADIATION. Barkai-Golan, Rivka; Kahan, R. S.; Temkin-Gorodeiski, Naomi (Volcani Inst. of Agricultural Research, Rehovoth, Israel. Soreq Nuclear Research Centre, Yavne, Israel). Int. J. Appl. Radiat. Isotop., 19: 579-83(July 1968).

Direct effects of gamma rays on suspensions containing 10^5 spores/ml of the main fungi in Israel that cause the rot in stored melons were examined by inoculating irradiated suspensions on Potato Dextrose Agar into melon fruits. A 40 krad dose was lethal to *Trichothecium roseum*, which was extremely sensitive. A 100 krad dose was lethal to *Penicillium cyclopium*, and *P. viridicatum* in vitro, while 150 krad was the lowest lethal dose tested in vivo. Lower doses (60 and 100 krad) caused some prolongation of the incubation period in melons stored at 17°C. The incubation period of *Fusarium sp.* inoculated into melons was 16–18 days for 100 krad doses, compared to ten days for controls. Its incubation was inhibited on melons by 200 krad for 24 days at 17°C, but there was a slow growth at 25°C in vitro between the 16th and 21st days. *Alternaria tenuis* was radiation resistant with 300 krad sublethal both in vitro and in vivo. (auth) (UK)

43483 SURVIVAL AFTER FRACTIONATED DOSES OF RADIATION: MODIFICATION BY ANOXIA OF THE RESPONSE OF CHLAMYDOMONAS. Bryant, P. E. (Medical Research Council, London). Nature (London), 219: 75-7(July 5, 1968).

Some studies are reported with *Chlamydomonas reinhardi*, in which recovery effects are very large, using a linear accelerator electron beam at a dose rate of 25 kR/min. Doses were separated by intervals of 10 min to 4 hours. Results are tabulated and shown graphically. There was a rapid increase in recovery during the first half-hour between doses, after which the recovery rate decreased, and the curve flattened to a plateau between 2 and 4 hours. Results indicated that oxygen was required for repair of sub-lethal damage, and that this repair occurs even if oxygen is excluded during irradiation. If, however, irradiation was sufficiently protracted for significant repair to occur during its course, the extent of recovery was considerably reduced in anoxic conditions. It seems likely that the concentration of oxygen required for complete effectiveness of repair processes may be considerably less than that required to confer full radiosensitivity during irradiation. It may be that the oxygen concentration needed for maximum repair is comparable with that at which the respiration rate is affected. (UK)

43484 THE EFFECT OF UV RADIATION ON THE GROWTH OF PLANTS AND THE PIGMENT CONTENT OF PLASTIDS UNDER THE CONDITIONS OF ARAGATS MOUNTAIN. **Narinyan, S. G.; Della-Rossa, R. G.; Voskanyan, V. E. (Botanical Inst., Erevan). Izv. Akad. Nauk Arm. SSR, Biol. Nauki, 18: No. 2, 37-40(1965). (In Russian).**

As a site for experiments on uv effects on various plants, the alpine region of Aragats mountain (3225 m above sea level) in the South Caucasus was used, where a distinctly continental temperature range prevails and where the minimum short wavelength of uv radiation is 285 mμ. To investigate the solar uv radiation effects on the growth of plants and on their chlorophyll content, the plants were placed for growth under a window pane and a polyethylene covering. The results showed that with low doses of 285-mμ radiation only 50% was transmitted through the polyethylene covering and that its passage through the window pane was completely prevented. However, high doses of 310- to 340-mμ uv rays, considered essential to active growth, were transmitted to a greater extent through both coverings. The tabulated results showed that natural uv radiation reduced the chlorophyll content by 3 to 7% in experimental plants grown under both coverings between July and September and that the same growth conditions had more detrimental effects during the early cultivation stages on the farm plants than on the alpine plants. (BBB)

Radiation Effects on Microorganisms

Refer also to abstracts 43239, 43287, 43288, 43357, 43361, 43505, 43513, and 43515.

43485 INTERACTION OF X-RAY AND ULTRAVIOLET RAY IN KILLING CELLS. Bhaumik, G.; Bhattacharjee, S. B. (Saha Inst. of Nuclear Physics, Calcutta). Nature (London), 218: 1077-8(June 15, 1968).

The mechanisms of cellular inactivation by x-rays and uv light have been suggested to be different. Studies on the killing of various bacteria by these two forms of radiation have suggested that preliminary uv exposure increases sensitivity to x-rays, but preliminary exposure to x-rays only removes the shoulder of the uv survival curve. Studies with strains of E. coli B, B/r and B_{s-1} were made, which substantially corroborated these findings. In the case of an auxotrophic strain, E. coli 15 T-A-U-, the findings were, however, rather different. X-irradiation was carried out at 80 kV and 9 mA, and the dose rate was 6 kR/min. The dose rate for uv irradiation was 27 ergs/mm^2/sec. The influence of various doses of uv light on the x-ray survival and the influence of x-rays on the uv survival of E. coli 15 T-A-U- are shown graphically. All the results of synergism between x-rays and uv light can be explained to some extent in terms of damage to the repair mechanism. If cooperation between the killing agents extends beyond destruction of the repair mechanism, the survival curves should show an increasing slope. This was found to be the case for E. coli T-A-U-, in contrast with the results for E. coli B/r or B, where the observed synergism is a direct result of the destruction of the repair mechanism. For E. coli 15 T-A-U- it appears that increase in sensitivity occurs in two steps, the first as far as a prior x-ray dose of 30 kR, and the second beyond this dose. (UK)

43486 EFFECT OF GAMMA IRRADIATION ON DEVELOPMENT OF FUNGI, BOTRYTIS CINEREA AND RHIZOPUS NIGRICANS, CAUSING ROT IN STRAWBERRY FRUITS. Barkai-Golan, Rivka (Volcani Inst. of Agricultural Research, Rehovot, Israel); Temkin-Gorodeiski, Naomi; Kahan, R. Sidney Food Irradiat., 8: No. 1-2, 34-6(July-Dec. 1967).

The effect of ^{60}Co γ irradiation on the culture and pathogenicity of Botrytis cinerea and Rhizopus nigricans, organisms responsible for most of the storage rots in strawberries, was studied. R. nigricans was the more resistant to radiation. Doses of 100 and 200 kRad did not reduce the development rate of the fungus in culture. While 300 kRad did slightly reduce growth rate, formation of the sporangia was unaffected at this dose. Irradiation of B. cinerea with 100 kRad did not affect the development rate in culture but 200 kRad caused a prolongation of the incubation period, while after 300 kRad there was total inhibition of the growth of the inoculum in culture. Irradiation of R. nigricans inocula with 100 kRad somewhat reduced the growth rate of the fungus after inoculation into the fruit. The effect became more marked after doses of 200 and 300 kRad. A dose of 100 kRad to B. cinerea inocula had no inhibitory effect on the fungal development when inoculated into the fruit. Doses of 200 and 300 kRad resulted in a slight prolongation, to three to four days, of the incubation period of the fungus in the fruit. (auth)

43487 LETHAL DOSES OF GAMMA RADIATION OF CERTAIN SPOILAGE FUNGI OF STORED RICE. Chowdhury, S. U.; Hossain, M. M. (Atomic Energy Centre, Dacca, East Pakistan). Food Irradiat., 8: No. 1-2, 30-33(July-Dec. 1967).

Certain fungi responsible for spoilage of stored rice in East Pakistan were isolated and identified. Six different species of fungi namely, Mucor fragilis, Aspergillus ochraceous, Aspergillus ustus, Aspergillus tamarii, Rhizopus oryzae and Aspergillus versicolor were found to be capable of bringing about decay of rice in storage. The lethal doses for these fungi were determined in situ and in-isolation. When the fungi were cultured immediately after irradiation, the lethal doses in situ varied from 192 kRad to 225 kRad and in-isolation from 175 kRad to 215 kRad depending on the species of fungi under investigation. These doses were higher than those required when the fungi were cultured 24 hours after irradiation, except in the cases of A. ustus at in situ irradiation, and A. versicolor at irradiation in-isolation where the doses required were higher than those at immediate plating. (auth)

43488 INFLUENCE OF γ-IRRADIATION AND HEATING IN THE PRESENCE OF A BACTERICIDE ON THE INACTIVATION OF BACILLUS SUBTILIS SPORES. Deasy, P. B.; Kuester, E.; Timoney, R. F. (University Coll., Dublin). App. Microbiol., 16: 810-11(May 1968).

Aqueous suspensions of Bacillus subtilis spores were γ-irradiated with 150,000 rad while sealed in glass ampoules under air, oxygen, or nitrogen. Irradiated and non-irradiated suspensions were heated at 80°C. Results indicated that irradiation of B. subtilis, especially in the presence of oxygen, sensitizes the remaining viable organisms to a heat treatment at 80°C. The inactivation rates of spore suspensions irradiated under air, oxygen, or nitrogen with chlorocresol added just prior to the heat treatment were all greater than the inactivation rate of a nonirradiated control. (H.L.W.)

43489 CHANGES OF DRUG RESISTANCE OF COLIFORM FECAL MICROFLORA IN PIGS AFTER TOTAL-BODY X-IRRADIATION. Kunstyr, Ivo; Mikula, Ivan; Sokol, Augustin; Stavarek, Vojtech (Veterinary Research Unit, Prague. Veterinary Faculty, Kosice, Czech.). Strahlentherapie, 135: 632-9(May 1968).

Conventional healthy piglets (11 to 15 kg) kept in a group were fed a diet without antibiotics. Coliform organisms were cultivated from the feces and tested, as a whole population, for resistance to seven antibiotics before and after whole-body x irradiation of the animals at sublethal (550 R) and half-lethal (600 R) doses. Nearly 100% resistance to tetracyclines before exposure, induced by previous feeding doses of chlortetracycline, was depressed 24 hours after irradiation to 30 to 35%. Later the resistance rose gradually, reached the normal on about 20th day, and by the 28th day it was even somewhat higher (resistance to a greater number of antibiotics) than before irradiation of the animals. Equally, the associated resistance of isolated resistant strains was higher in the postirradiation period. Neither quantitative changes nor changes in biochemical properties of strains isolated in the postirradiation period of resistance depression were detected. (auth)

43490 SHAPES OF THE U.V. INACTIVATION CURVES FOR SINGLE AND LINKED DOUBLE MARKERS IN HAEMOPHILUS INFLUENZAE TRANSFORMING DNA. Rupert, C. S. (Southwest Center for Advanced Studies, Dallas). Photochem. Photobiol., 7: 437-49(May 1968).

The known inverse square law $S = 1/(1 + CD)^2$, relating survival of transforming activity S to ultraviolet (uv) dose D, C being a constant, fails for two linked-double genetic markers in H. influenzae. For these double markers the law is $S = 1/(1 + CD)^4$, both for uv and nitrous acid inactivation. A theoretical model that predicts the inverse square law for singles also predicts the inverse fourth power law for linked doubles, if the possibility of an even number (>0) of genetic recombinations between the markers is allowed for. However, it can be shown rather generally that other models, not specified in exact detail, can lead to the same inverse square law for single markers, and thus to the inverse fourth power law for sufficiently separated linked-doubles. Ability to predict these laws is not, therefore, strong evidence for the validity of any one model. For all these models, the mean number of damaging lesions per unit length of DNA is directly proportional to dose, making $(\sqrt{(1/S)} - 1)$ for single markers and $(\sqrt[4]{(1/S)} - 1)$ for loosely linked-doubles a reasonable biological measure of inactivating damage in the DNA. (auth)

43491 DARK RECOVERY OF HAPLOID YEAST CELLS AFTER X-IRRADIATION. de Langguth, E. N. (Max-Planck-Institut fuer Biophysik, Frankfurt am Main). Biophysik 5: 32-41(1968). (In German).

Recovery of haploid yeast cells (Saccharomyces cerevisiae) from x ray damage was studied by single cell observation. At least two intervals in the cell cycle with different radiation sensitivity were present. Recovery from x ray damage was possible only in cells irradiated during the radiation insensitive interval. However, those cells showed one hundred percent recovery in the dose range studied up to about 100 Krad. (auth)

43492 INOSITOL, OXYGEN, AND WATER EFFECTS ON THE X-RAY SENSITIVITY OF SERRATIA MARCESCENS. Tetteh, G. K.; Cormack, D. V. (Univ. of Saskatchewan, Saskatoon, Can.). Radiat. Res., 34: 532-43(1968).

The variation of radiosensitivity of Serratia marcescens with relative humidity (R.H.) was investigated under aerobic and anoxic conditions, utilizing filter and aerosol techniques for drying. Also, the action of inositol in protecting cells against x-ray damage was investigated. Results showed that the radiosensitivity of the filter-mounted cells varied from 0.61 kRad^{-1} at 98% R.H. to a minimum of 0.31 kRad^{-1} at 80% R.H., increased with decreasing R.H. to 0.28 kRad^{-1} at about 55% R.H., and then decreased again to 0.15 kRad^{-1} at 40% R.H. and below. The changes in sensitivity appear to correspond to changes in the water associated with DNA and support the suggestion that DNA is the essential molecule, the damage of which leads to inactivation. A constancy of radiosensitivity for inositol-protected cells was observed below 80% R.H. The results suggest that inositol reduces damage due to water-radiolytic products by its ability to replace structural water molecules. (auth)

Radiosterilization and Radiopreservation

Refer also to abstracts 43204, 43482, 43486, and 43487.

43493 (NYO-3422-1(Vol.1)) SHORT-TERM SUBACUTE ANIMAL FEEDING STUDIES ON RADIATION-PASTEURIZED FOODS (SWEET CHERRIES, APRICOTS, PRUNE-PLUMS). Final Report. Gabriel, Karl L.; Edmonds, Russell S. (AME Associates, Princeton, N. J.). Jan. 31, 1966. Contract AT(30-1)-3422. 371p. Dep. CFSTI.

Data are presented in tabular form on the effects of radiation-pasteurized sweet cherries, apricots, and prune-plums when fed to albino rats and beagle dogs at the rate of 35% dry weight in feed for 90 days. The irradiated fruits were exposed to 400,000 rads in a ^{60}Co irradiator and freeze-dried for use in the diets. The protein, carbohydrate, and fat contents of the rat and dog diets were maintained at 20-22%, 60-60%, and 8-8% respectively. The rats and dogs were both fed excess amounts of the diets. After 90 days the animals in both control and irradiated groups were sacrificed and data collected on the pathology and weight of individual organs. Data were also collected on the hematological and physiological effects of the various diets. Results are expressed in terms of short-term, subacute effects. (E.R.B.)

43494 (NYO-3422-1(Suppl.)(Vol.1)) SHORT-TERM SUBACUTE ANIMAL FEEDING STUDIES ON RADIATION-PASTEURIZED FOODS (ONIONS). Final Report. Gabriel, Karl L.; Edmonds, Russell S. (AME Associates, Princeton, N. J.). Feb. 28, 1966. Contract AT(30-1)-3422. 233p. Dep. CFSTI.

Data are presented in tabular form on the effects of radiation-pasteurized onions when fed to albino rats and beagle dogs at the rate of 35% dry weight and 10% dry weight respectively for 90 days. The irradiated onions were exposed to 25,000 rads in a ^{60}Co irradiator and air-dried for use in the diets. The protein, carbohydrate and fat contents of the rat and dog diets were maintained at 20-22%, 60-60%, and 8-8% respectively. The rats and dogs were both fed excess amounts of the diets. Data were collected from rats and dogs at 30 day intervals and at autopsy after the 90 day period on body weight, hematology, clinical chemistry, intestinal enzymes, organ weights, and organ to body weight ratios. Statistical evaluations were performed on the data, and results are expressed in terms of short term, subacute radiation effects. (E.R.B.)

43495 (NYO-3422-1(Vol.2)) [SHORT-TERM SUBACUTE ANIMAL FEEDING STUDIES ON RADIATION-PASTEURIZED FOODS (SWEET CHERRIES, APRICOTS, PRUNE-PLUMS)]. Final Report. Gabriel, Karl L.; Edmonds, Russell S. (AME Associates, Princeton, N. J.). Jan. 31, 1966. Contract AT(30-1)-3422. 432p. Dep. CFSTI.

The pathology reports are presented in tabular form on the internal organs of albino rats. The rats were sacrificed following a 90 day period during which they were fed excess diets containing ^{60}Co γ-irradiated apricots, plums, or sweet cherries. The fruits were irradiated to 400,000 rads. Statistical evaluation of the data indicates that there was no significant difference in the pathology of the internal organs of the rats between the irradiated and control diet groups. (E.R.B.)

43496 (NYO-3422-1(Suppl.)(Vol.2)) [SHORT-TERM SUBACUTE ANIMAL FEEDING STUDIES ON RADIATION-PASTEURIZED FOODS (ONIONS)]. Final Report. Gabriel, Karl L.; Edmonds, Russell S. (AME Associates, Princeton, N. J.). Feb. 28, 1966. Contract AT(30-1)-3422. 241p. Dep. CFSTI.

The pathology reports on the internal organs of albino rats and beagle dogs. The rats and dogs were sacrificed following a 90 day period during which they were fed an excess diet containing ^{60}Co γ-irradiated onions. The onions were irradiated to 25,000 rads. Statistical evaluation of the data indicates that there was no significant difference in the pathology of the internal organs of the rats and dogs between the irradiated and control diet groups. Data are also presented on the hematological and physiological findings in the irradiated and control diet groups of dogs. (E.R.B.)

43497 (PRNC-100) RADIATION-INDUCED STERILITY FOR POPULATION CONTROL OF THE SUGARCANE BORER DIATRAEA SACCHARALIS (FAB.) IN PUERTO RICO. Summary Progress Report, 1964-1967. Walker, David W. (Puerto Rico Nuclear Center, Mayaguez). Apr. 1967. Contract AT(40-1)-1833. 23p. Dep. CFSTI.

The purpose of the project was to determine if the sugarcane borer could be eradicated by the release of sterile adults. Implicit in this objective was a number of related aspects: to determine the stage and point within the stage to be sterilized; to determine if the life-span, fecundity, mating capability and general vigor is affected by sterilizing; to develop a laboratory method for mass-producing this insect capable of producing large numbers of individuals at a low cost; and to study the life cycle in the laboratory and under field conditions with particular reference to growth rate, reproductive potential, mating behavior, and other aspects of the bionomics and ecology relevant to a successful overflooding program. The first objective was completed. Only the adult stage can be sterilized without producing excessive somatic damage and subsequent high mortality. Larval and pupal stages can be sterilized at much lower exposures. The dose/sterility effect relationship appears to be roughly exponential, but there is considerable variation in individual tests at sub-sterilizing exposures. Life span and oviposition rate is not affected by sterilizing the adults of either sex. Mating capability of sterile adults is equal or slightly superior to normal adults. The artificial diet developed is well-adapted to rearing the insect if the insect is continually provided with fresh food. The high labor investment of manually removing larvae from contaminated to fresh food is an unsolved problem. The second major problem in mass-rearing is to develop a low cost diet. High food-cost and contamination problems are inherent in rearing lepidoptera under artificial conditions. Considerable data were obtained on growth rate in laboratory rearing but there have not been extensive field studies on this insect in Puerto Rico. Some indirect inferences on the net natural reproductive rate can be made from field tests in cages, but it would be risky to extrapolate this data to field conditions of cane production. The potential for eradicating this species through a combined program of trapping using synthetic pheromone in combination with the release of sterile adults appears to be promising. Limitations of this program include: lack of a good rearing method, and incomplete knowledge of the biology of this species under field conditions. Further field work and a mass-rearing method will have to be developed before the program will be ready for large scale field testing. (E.R.B.)

43498 (STI/DOC-10/72) RADIOSTERILIZATION OF MEDICAL PRODUCTS, PHARMACEUTICALS AND BIOPRODUCTS. Technical Reports Series No. 72. Report of a Panel Held in Vienna, January 17-19, 1966. (International Atomic Energy Agency, Vienna (Austria)). Mar. 1967. 94p. IAEA: $2.00; Austrian Schillings 52,- 14/2 stg; F Fr 9,80; DM 8,-.

The objectives of the panel were to review the activities of member states in the field of radiosterilization of medical products and to formulate a code of practice to be applied internationally in conformance with existing international laws. A paper on aspects of radiation microbiology fundamental to the sterilization process is followed by individual reports from the United States of America, the United Kingdom, Denmark, France, the USSR, Belgium, the Czechoslovak Socialist Republic, the Federal Republic of Germany, Hungary, the IAEA, Italy, Sweden, and Switzerland. Recommendations for a code of practice for radiosterilization of medical products are given. (auth)

43499 (TID-24256) STUDY OF IRRADIATED-PASTEURIZED FISHERY PRODUCTS. Period Covered: October 1, 1966-September 30, 1967. Ronsivalli, L. J.; Ampola, V. G.; King, F. J.; Holston, J. A. (Bureau of Commercial Fisheries, Gloucester, Mass. Technological Lab.). July 1968. Contract AT(49-11)-1889. 94p. Dep. CFSTI.

From October 1966 to September 1967 the maximum shelf life study was continued, an expert organoleptic panel that could estimate the shelf life of cod fillets was developed, and the efficiency of various levels of γ radiation for preserving fish and shellfish was tested. In applied radiation chemistry research, we investigated the effect of radiopasteurizing doses of γ radiation on spoilage patterns in fish and the effect of a broad range of dose levels of γ radiation on the composition of volatile chemical components in fish were investigated. The data obtained thus far in the maximum shelf life study indicate that some variability in the results that is dependent on differences between lots of fish can be expected. These differences can be minimized by comparing maximum shelf life data with toxin development data. It would then be more meaningful to express the results in terms of the safety factor (toxin development time minus maximum shelf life) for each particular lot. Both expert and untrained odor panels indicated that radiopasteurized fillets became as offensive when finally rejected as did the nonirradiated samples when they were rejected—the former simply spoiled at a slower rate. It is reasonable to expect that there may, however, be differences in the types of spoilage odors as functions of radiation dose level and storage temperatures. An expert panel that was capable of estimating the shelf life of cod fillets stored at 33°F with a precision of ±2 days in 97% of the total analyses thus far was developed, and trained to evaluate the quality of raw cod fillets by the odor of the fillets. The expert panel conducted a storage study with radiopasteurized (150 kilorads) and nonirradiated cod fillets stored at 33–47°F. The data obtained clearly demonstrate the panel capability to express the quality of radiopasteurized fillets stored at temperatures in the range of 33–47°F in terms of nonirradiated iced fillets. The results of an experiment designed to test the efficiency of 50 kilorads of γ radiation for preserving the fillets of three species of fish stored at different refrigeration temperatures indicated this dose level is too low and that the recommended range of radiation for pasteurizing fish fillets (100–200 kilorads) is appropriate. Continuing work with scallops indicated that irradiation at a level of 100 kilorads was effective for pasteurizing this species. In one experiment conducted it was found that quick frozen, fresh shrimp were as good as fresh shrimp for use as quality-reference samples. In applied chemistry research two new petition-oriented studies were initiated that are expected to produce objective evidence regarding the effect of radiation on the spoilage pattern in fish and the effect of different levels of radiation on the composition of volatile compounds in fish. Preliminary results show that irradiation doses have effects in both cases, but the importance of these effects are not yet known. (E.R.B.)

43500 THE EFFECTS OF GAMMA IRRADIATION OF WHEAT FLOUR ON ITS MICROFLORA AND VITAMIN B_1 CONTENT. Poisson, J. (CERDIA, Massy, France); Jemmali, M.; Cahagnier, B.; Leclerc, J. Food Irradiat., 8: 2-11(July-Dec. 1967).

Results are presented on the effects of ^{60}Co γ irradiation on the microflora and vitamin B_1 content of wheat flour. The effects of moisture content of the flour and the method of preparation for processing were determined. The effect of these parameters was found to be greater than the radiosensitivity of vitamin B_1. Storage at 5°C yielded a lower microflora count in the irradiated samples than in non-irradiated controls stored at the same temperature. (E.R.B.)

43501 CONSTRUCTION OF THE PROEFBEDRIJF VOEDSELBESTRALING IN HOLLAND. Ulmann, R. M. Food Irradiat., 8: No. 1-2, 12-15(July-Dec. 1967).

Plans and objectives are presented for the Proefbedrijf Voedselbestraling food irradiation facilities at Wageningen, Holland. Economic, legislative, and social obstacles are discussed and the desire for cooperation and support of the E.A.G.G.F. with the Common Market is expressed. The facility will use a cobalt-60 γ-source and a Van de Graaff accelerator as an electron source. The facility will be limited to the irradiation of packaged foods. (E.R.B.)

43502 COMBINED USE OF GAMMA IRRADIATION AND SORBIC ACID FOR PRESERVATION OF INDIGENOUS EVAPORATED MILK PRODUCT, KHOA. Bongirwar, D. R.; Kumta, U. S. (Bhabha Atomic Research Centre, Trombay, India). Food Irradiat., 8: No. 1-2, 16-20(July-Dec. 1967).

A combination process, using ^{60}Co γ rays and sorbic acid-coated wrappers is described for the extension in shelf-life of Khoa, an indigenous evaporated milk product. The retention of organoleptic characteristics of Khoa is high for doses up to 0.5 Megarad, but declines with higher doses, in contrast to effects of low dose irradiation (0.5 Megarad) or sorbic acid treatment alone. The combined treatment retards onset of mold on Khoa, for 15 to 17 days and 20 to 27 days when stored at 35 to 40°C and 10 to 12°C respectively. (auth)

43503 EFFECT OF GAMMA RADIATION ON GUAVAS (PSIDIUM GUAJAVA L). Farooqi, W. A.; Mumtaz, Ali; Amir, Muhammed (Atomic Energy Centre, Lahore). Food Irradiat., 8: No. 1-2, 37-40(July-Dec. 1967)

Fresh guavas were subjected to pasteurization levels of γ radiation applied in conjunction with commercial procedures of handling. The fruits were stored at room temperature after irradiation and evaluated for color, appearance, texture, taste and flavor, sugars and vitamin C content. The quality of the fruit was not affected up to a dose of 30 kR and there was no significant loss of vitamin C and sugar content at this radiation dose. (auth)

43504 GAMMA IRRADIATION OF ARRACACIA XANTHORRHIZA, A VENEZUELAN NETRITIONS VEGETABLE. Revetti, L. M. (Instituto Venezolano de Investigaciones Cientificas, Caracas). Food Irradiat., 8: No. 1-2, 41-3(July-Dec. 1967).

Tubers of Arracacia xanthorrhiza having similar shapes and weights were collected from the field and γ-irradiated 24 hrs later. After homogenization, aliquots were analyzed for catalase, reducing sugars, starch, and vitamin C. Shelf life was considerably increased by irradiation. (H.L.W.)

43505 γ-IRRADIATION EFFECT ON MICROFLORA OF RICE. Iizuka, Hiroshi; Ito, Hitoshi (Tokyo Univ.). Food Irradiat., 8: No. 1-2, 21-9(July-Dec. 1967).

Unpolished and polished rice harvested in Japan, and polished rice imported from Spain were investigated. Chromogenic Pseudomonas and fluorescent Pseudomonas were found to be the main microflora of unirradiated Japanese rice, either unpolished or polished. Twenty to thirty per cent of microorganisms in Spanish rice were found to be molds, and the rest chromogenic Pseudomonas and fluorescent Pseudomonas. It was found that the main microorganisms of rice, including molds such as Penicillium and Aspergillus that are the main microorganisms in rice concerned with damage, can be sterilized with a dose of 0.2 to 0.3 MR. When rice was irradiated at a dose of 0.2 to 1.2 MR, only red Pseudomonas was found as a main surviving species. It should be noted that radioresistant yeasts were isolated from unpolished rice irradiated with a dose of 1 MR or more. No increase in the number of microorganisms was observed in irradiated rice packaged in a polyethylene pouch after 30 day storage at 10 and 30°C. (auth)

43506 CONTROL OF FOOD IRRADIATION IN THE UNITED KINGDOM. Neal, W. T. L. Food Irradiat., 8: No. 1-2, 45-7 (July-Dec. 1967).

A review is presented of the legal and administrative machinery recently set up in the United Kingdom to control exposure of food to ionizing radiation. Regulations prohibit the irradiation of food intended for sale for human consumption if the dose administered to the food exceeds 10 RADs. The regulations also prohibit the sale of food that was irradiated with doses in excess of 10 RADs regardless of whether the irradiation was carried out inside or outside the United Kingdom. (H.L.W.)

43507 IRRADIATION OF POTATOES IN PAKISTAN. Farooqi, W. A.; Mohyuddin, M.; Hamid, M. A. (Atomic Energy Centre, Lahore). Food Irradiat., 7: 41-4(Jan.-Mar. 1967).

Fifteen days after harvest, samples of 80 potatoes selected at random were weighed and γ-irradiated in bulk in polyethylene bags; dose administered to each package were 2, 4, 6, 8, or 10 kRad. The potatoes were then removed from the bags and stored in wooden racks at 83°F (average) and 69% relative humidity; weight loss due to storage and sprouting, sprout length, and rot incidence were all determined. Results are presented in tabular form. It was concluded that with the increase in radiation dose, loss of water content and the incidence of storage rot were greatly reduced. The 2 kRad dose exerted a stimulation effect on sprouting. (B.S.L.)

43508 STUDIES ON AN EXPERIMENTAL POPULATION OF DROSOPHILA MELANOGASTER RAISED ON IRRADIATED BANANA DIET. Hossain, M. M.; Mollah, M. S. Alam; Malik, M. U. (Atomic Energy Centre, Dacca, Pakistan). Food Irradiat., 7: 45-9(Jan.-Mar. 1967).

Seven generations of Drosophila melanogaster were fed irradiated banana diet. Banana treated with 35,000, 45,000, and 55,000 Rad was compared with untreated banana for effect on egg-pupae ratio, percent adult emergence, longevity, egg-production and viability in order to assess possible toxicity or changes in nutritive value or mutagenic effects. No effects were found that could be attributed to irradiated food. (auth)

43509 START OF THE EXPERIMENTAL FOOD IRRADIATION PLANT. Atoomenergie Haar Toepass., 10: 35-42(Feb. 1968). (In Dutch).

The experimental food irradiation plant at Wageningen, the Netherlands, went into operation during January 1968. A ^{60}Co source and an electron accelerator are used for irradiation of many food products on a semi-industrial scale, preferably 3000 kG or more of one product per treatment. Currently the plant is used to preserve mushrooms, fish fillets, meat products, ham, shrimp, petfood, and food for hospital test animals. Irradiation of chicken, canned vegetables, herring and strawberries is planned for the near future. The plant provided the food producer with the packaging material in sizes suited to the radiation facility and to the needs of the retailer; after packaging, the food was irradiated. (J.J.t. B.)

43510 USING GAMMA RAYS FOR STERILIZATION OF HARMFUL INSECTS. Andreev, S. V.; Martens, B. K.; Molchanova, V. A.; Saldan, L. N. (All-Union Inst. of Plant Protection, Moscow). Vestn. Sel'skokhoz. Nauki, Min. Sel. Khoz. SSSR, No. 1, 48-52(Jan. 1967). (In Russian).

Radiosterilization of insects in agriculture is briefly reviewed. The effects of γ radiation on the reproductive organs of insects and optimum doses for induction of sterilization are discussed. Dynamics of egg hatch of the new generations and sterilizing effects on Acanthoscelides obsoletus produced by γ irradiation of the beetles at 1000 and 6000 R doses are evaluated and discussed. It was indicated that eradication of populations of pea weavils (Bruchus chinensis) and Acanthoscelides obsoletus could be achieved by radiosterilization. (R.V.J.)

43511 PROGRESS OF FOOD IRRADIATION WORK AND PROGRAMMES IN O.E.C.D. MEMBER COUNTRIES. Food Irradiat., 7: 2-40(Jan.-Mar. 1967).

Programs for radiation processing of foodstuffs and radiosterilization of insect pests and medical supplies in Austria, Belgium, Canada, Denmark, France, Germany, Italy, Japan, Netherlands, Spain, Sweden, Switzerland, United Kingdom, and the United States of America are described. Legislation, wholesomeness tests, pilot plants and industrial developments, sources and dosimetry, and future programs for each country are also described. (B.S.L.)

43512 KEEPING SEA FOOD FRESH. Int. At. Energy Agency Bull., 10: No. 3, 20-3(1968).

The program for shore-based experiments on radiation processing of fish in Iceland is briefly outlined. A nuclear irradiation unit, designed for use on board ship, will be installed on land for the project. The food irradiator is very briefly described; an illustration appears in the text. (B.S.L.)

43513 EFFECT OF GAMMA RADIATION ON THE DESTRUCTION RATE OF AN OSMOPHILIC YEAST (SACCHAROMYCES STEINERI). Bhattacharya, S.; Anand, J. C. (IARI, Delhi). Indian Food Packer, 20: No. 1, 13-15(1966).

The lethal effect of ionizing radiation on S. steineri, an osmophilic yeast, isolated from apple preserve was studied. Increase in the dose of irradiation with γ rays resulted in progressive decline of viable count of the organism. Increased concentrations of sugar in the syrup seemed to render a protective influence on the death rate of the organism against γ irradiation. Also it was observed that the lethal effect of irradiation was enhanced in glucose syrup as compared to sucrose. 19 ref. (Indian Sci. Abstr.)

43514 PROBLEMS CONCERNING INNOCUITY OF FOOD PRESERVED BY IONIZING RADIATION. Wolf, A. (Lehrstuhl fuer Ernaehrungshygiene, Prague). Vitalst. Zivilisationskr., 13: 74-5(Apr. 1968). (In German).

Various aspects of the effects of ionizing radiation on foods are discussed. The risk of secondary radiation in preserved food is practically negligible if the radiation technique is properly carried out. Loss of biological value was studied with regard to vitamins A, B_1, B_2, C, and E, proteins, fats, and carbohydrates, and it was concluded that the loss was no greater than that occurring in foods preserved by thermal processes. In order to study the possible toxic effects of irradiated foods, four generations of mice, rats, dogs, guinea pigs, chickens, and other animals were fed radiosterilized food without pathological results. Delayed effects of radiation on casein and potatoes were observed; however, after three to six weeks the effects disappeared. (H.L.W.)

43515 DISINFECTION, STERILISATION, AND PRESERVATION. Lawrence, C. A.; Block, S. S. London, Kimpton, 1968. 808p. 270s.

Sections are included on the destruction of micro-organisms by ionizing radiation, and on sterilization by ultraviolet radiations. (UK)

43516 GAMMA IRRADIATION FOR DISINFESTATION OF EXPORT FRUITS AND VEGETABLES. **Steiner, Loren F. (Univ. of Hawaii, Honolulu). Hawaii Farm Sci., 15: 11-12(Jan. 1966).**

Doses of γ radiation not less than 21 Krad can be used in lieu of ethylene dibromide and methyl bromide fumigation, or vapor heat treatment to eradicate the dangerous pests in Hawaii fruits and vegetables and thus permit immediate export of the commodity. Important advantages are the short period required for radiation treatment and the absence of fumigant residues that necessitate long post-treatment ventilation periods and prevent quick chilling after picking. Where the shelf life can be extended without inducing adverse effects by using high radiation doses, the advantage in substituting irradiation for other disinfestation treatments is materially increased. Ten Krad or more of γ irradiation will produce irreversible sterility in flies that emerge from pupae treated 1 or 2 days before emergence. A 21-Krad dose will kill eggs and larvae or prevent their development beyond the pupal stage. Marketable fruit rarely, if ever, contains fruit flies in the pupal stage. There must be no possibility that adult flies, even if sterile, will emerge from fruit that reaches the U. S. mainland. If the dose is not high enough to prevent adult emergence, mainland authorities might have to institute an unnecessary, expensive eradication program since differentiation between newly emerged sterile and normal flies is often impossible. The mango weevil lives from young larva to adult within the seeds of mangoes. Irradiated mangoes could carry live adults to the U. S. mainland. If a minimum dosage of about 25 Krad is required, most of the adults in treated fruit will weaken and die without escaping from the seed. Any that survive would be sterile. (BBB)

43517 RADIATION PASTEURIZATION OF KAMABOKO FISH CAKE. **Kashiwagi, Midori; Brewbaker, James L. (Univ. of Hawaii, Honolulu). Hawaii Farm Sci., 15: 10-11(Jan. 1966).**

The Japanese fish cake, kamaboko, spoils in several days under commercial refrigeration temperatures. The reported studies suggest that this spoilage may be controlled by radiation pasteurization. Kamaboko is made from a mixture of fish, cornstarch, sugar, and monosodium glutamate, a mixture that is cooked by steaming and then molded. Doses of 100 to 1600 Krad on fish cake stored at 5°C were tested. Even at the lowest dose the shelf life was lengthened significantly. At doses of 450 Krad and above, the samples did not slime even after 94 days. Because of mold formation on the exterior of the packaging material of some of the samples, the experiment was terminated after 94 days. To determine the effect of γ irradiation on the flavor of the fish cake, taste panel tests were made. There was a slight color change at the highest dosage (1600 Krad) from white to light tan. There was also a slight flavor change at this dose, but some judges considered the changes an improvement over the controls. To test for possible bacterial toxins resulting from the prolonged storage conditions, four 94-day-old irradiated samples that were free from slime and mold were ground, mixed thoroughly, and fed to growing rats for two successive days. There were no apparent changes in their physical conditions which indicated that the samples were free of bacterial toxins. (BBB)

43518 EFFECT OF GAMMA RADIATION ON TOMATO FRUIT PICKED AT FOUR STAGES OF DEVELOPMENT. Lee, T. H.; McGlasson, W. B.; Edwards, R. A. (Univ. of New South Wales, Kensington, Australia). Radiat. Bot., 8: 259-67(June 1968).

Tomatoes were picked at four stages of growth and subjected to γ-radiation doses of 200 and 400 kR. Immediately after irradiation the respiration rate of all treated fruits increased about two-fold, while ethylene evolution increased to a rate which was almost half of that observed during the ripening of normal, untreated tomatoes. Within 3 to 6 days, the respiration rates of all irradiated fruits diminished to those of the preclimacteric control fruit, and the evolution of ethylene fell to trace levels. Pronounced softening was also observed in fruit shortly after irradiation, but the less mature fruits regained practically all of their original firmness within 4 days. Delayed manifestations of certain responses to irradiation were revealed when the irradiated fruits were allowed to ripen, and these varied with the stage of development of the fruit at picking. Thus the onset of coloring in 93% stage fruit treated with 200 and 400 kR and 83%-stage fruit treated with 400 kR was uneven and slow. The ultimate color developed was similar to that of the control fruit, but the respiratory climacteric in these irradiated fruits was ill-defined, and ethylene production was lower than normal. There was no delay in the onset of coloring of 48%- and 75%-stage fruit treated with 200 kR. These young fruits had a well-defined respiratory climacteric and a high rate of ethylene evolution. Color development during ripening was normal in 75%-stage fruit treated with 200 kR, but 48%-stage fruit treated with 200 or 400 kR developed finally to a light red color instead of the orange-red of the control fruit. The apparent recovery of the respiratory mechanisms of young fruit from damage caused by doses up to 400 kR is discussed in relation to known effects of ionizing radiation on cell walls and on cell permeability in plant tissue. (auth) (UK)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

Refer also to abstracts 43627 and 43629.

43519 (ANL-7299) METALLURGY DIVISION ANNUAL PROGRESS REPORT FOR 1966. (Argonne National Lab., Ill.). Contract W-31-109-Eng-38. 327p. Dep. CFSTI.

Information in the report is presented in two parts. Part I is divided into eight sections. Part II is divided into eleven sections. A separate abstract was prepared for each of eighteen sections. The section for which no abstract was prepared is a summary of Part I. (J.R.D.)

For abstracts of individual sections see: 42994, 43520, 43526–43528, 43590–43596, 43613, 43614, 43627, 43628, 43631, and 43646.

43520 (ANL-7299, pp 138-43) DEVELOPMENT OF THORIUM-URANIUM AND THORIUM-URANIUM-PLUTONIUM FUELS. Blumenthal, B.; O'Boyle, D. R. (Argonne National Lab., Ill.).

Research and development progress is reported on Th–Pu phases, Th–Pu–U phases, thermal conductivity of Th–U–Pu alloys, irradiation of Th–U fuels, and irradiation of Th–U–Pu fuels. (J.R.D.)

43521 (IS-RD-14) REACTOR MATERIALS DEVELOPMENT QUARTERLY [REPORT] FOR DIVISION OF REACTOR DEVELOPMENT, USAEC, APRIL–JUNE 1968. Voigt, A. F. (ed.) (Ames Lab., Iowa). 48p. Dep. CFSTI.

Progress is reported on preparation of Th and other reactor metals, phase diagrams of rare earths and heat-resisting metal systems, behavior of reactor materials and liquid metals, high-temperature properties of ceramics and metal oxidation mechanisms. (J.R.D.)

43522 FLUORESCENT X-RAY ANALYSIS OF FERROSILICON, FERROMOLYBDENUM, FERROCHROMIUM, FERROSILICON-MAGNESIUM, FERROMANGANESE, AND CALCIUM-SILICON. Tsukamoto, Akira; Shimizu, Ikuzo; Ohata, Masahiko (Toyo Kogyo Co., Ltd., Hiroshima). Nippon Kinzoku Gakkaishi, 32: 473-8(1968). (In Japanesee).

Methods for preparation of ferroalloy samples for analysis by x-ray quantometry are described. Time required for analyzing one sample of ferrosilicon, ferrochromium, ferromanganese, ferromolybdenum, or Ca–Si systems, including sample preparation, is about 10 minutes. Coefficient of variation for each of the elements in the ferroalloys is about 1.7%. (P.G.C.)

43523 FLEXIBLE IONIZING RADIATION SHIELDING MATERIAL. Sedlak, Steve. British Patent 1,122,766. Aug. 7, 1968. Priority date Aug. 9, 1966, United States.

A new, improved flexible shielding material was developed which avoids the deterioration of previous lead particle–elastomer matrix materials. The deterioration is due to reaction of the lead particles with the elastomer, producing vulcanization. The new material comprises an elastomeric matrix material (e.g., rubber) and filler particles of a lead alloy which is nonreactive with the matrix. The alloy may include 5 to 10 wt % tin or antimony. Forms may be dipped into the formulation to form flexible shielding articles of wear. (D.L.C.)

43524 METALLURGIYA VOL'FRAMA, MOLIBDENA I NIOBIYA. (Metallurgy of Tungsten, Molybdenum, and Niobium). Reznichenko, V. A. (ed.). Moscow, Izdatel'stvo Nauka, 1967. 224p.

Thirty-two articles are contained on new technology and uses of high-melting metals. Technology of tungsten and molybdenum ore enrichment, hydrometallurgy of concentrates, and annealing of molybdenum concentrates are discussed. The preparation and properties of W, Mo, and Re metals and alloys are described. Electrochemical refining of W and Rb, chemistry of W chlorination, Mo complexing by oxalate ions, and separation of W and Mo are also discussed. (R.V.J.)

43525 RARE-EARTH METAL-REFRACTORY METAL SYSTEMS AND THEIR APPLICATIONS. Gaume-Mahn, F.; Madej, C. (Univ., Lyon). Progr. Sci. Technol. Rare Earths, 3: 515-(1968).

The study of the refractory metal–rare earth metal systems has been developed considerably. Important studies include: The solid-state quasi insolubility of rare earth and refractory metals. The possibility of refining refractory metals with the rare earths and improvement of their mechanical properties. The use of refractory metals as material for crucibles in rare-earth metallurgy. After reviewing the different systems which have been investigated, some details are given about the two last interesting applications. (auth) (UK)

Corrosion and Erosion

Refer also to abstracts 44820–44822, and 44857.

43526 (ANL-7299, pp 114-19) NUCLEAR SAFETY. (Argonne National Lab., Ill.).

Aspects of safety related to penetration of fuel jacket materials by liquid U–Pu–Zr and U–Pu–Ti alloys were investigated along with those associated with personnel exposures encountered during fabrication of reactivity-coefficient specimens. (J.R.D.)

43527 (ANL-7299, pp 150-72) DEVELOPMENT OF CORROSION-RESISTANT JACKET AND STRUCTURAL MATERIALS. (Argonne National Lab., Ill.).

Investigations of heat resisting metals by liquid metals such as Sn and Na are reported. Results of studies of oxygenated Na reactions with Ta and Nb are also discussed. Other research effort is described on internal-friction techniques for determination of O in Na and on Li corrosive effects on Ta. (J.R.D.)

43528 (ANL-7299, pp 309-21) CORROSION RESEARCH. (Argonne National Lab., Ill.).

Research progress is reported on low-pressure oxidation, Zr oxidation, polarization of metals, and aqueous corrosion of Al. (J.R.D.)

43529 (BAW-1280-53) TUBE BEND EROSION STUDY. Michaud, E. R.; Seifert, J. W. (Babcock and Wilcox Co., Alliance, Ohio. Research Center). June 24, 1968. Contracts AT(11-1)-1280; 596-3559-45-11. 57p. Dep. CFSTI.

The log of operation of the once-through steam generator at the B&W Research Center was surveyed to construct an approximate history of the kind of operation the generator tubing has undergone over the past ten years. A visual and low-powered magnification examination of the internal surfaces of tube samples from the steam generator was conducted to determine the presence of steam erosion. Results of visual and low-powered magnification examination combined with tube wall thickness measurements of tube samples from the steam generator showed no evidence of internal tube erosion. (P.G.C.)

43530 (BM-RI-7169) CORROSION PROPERTIES OF THE TZM AND MOLYBDENUM-30 TUNGSTEN ALLOYS. Acherman, Walter L.; Carter, J. P.; Schlain, David (Bureau of Mines, College Park, Md. College Park Metallurgy Research Center). Aug. 1968. 23p. Bureau of Mines Free.

The chemical and galvanic corrosion behavior of the TZM and molybdenum-30 tungsten alloys is equal or superior to that of unalloyed molybdenum in many aqueous solutions of acids, bases, and salts. Notable exceptions occurred in 1 N nitric acid, where both alloys corroded appreciably faster than molybdenum. In mercuric chloride solutions, the TZM alloy was susceptible to a type of crevice corrosion which was not due to differential aeration. The alloys were usually not adversely affected by contact with dissimilar metals in galvanic couple experiments, but the dissimilar metals sometimes corroded galvanically. Both alloys were resistant to substitute ocean water spray at 60°C. (auth)

43531 (TID-24567) THE RELATIONSHIP OF NITROGEN CONTENT OF AUSTENITIC STAINLESS STEELS TO STRESS CORROSION. Quarterly Report No. 483-16. Cox, Thomas B. (Virginia Polytechnic Inst., Blacksburg. Dept. of Metals and Ceramic Engineering). July 1968. Contract AT(40-1)-3208. 17p. Dep. CFSTI.

Specimens of Type 304 stainless steel with N contents ranging from 0.033 to 0.406 wt % were heat treated and aged to assure homogeneity and tested in boiling 42% $MgCl_2$ to determine effects of N and thermal aging on susceptibility to stress corrosion cracking. It was observed that increasing amounts of N in solid solution decreased times to crack-nucleation and to complete crack penetration while increasing rates of crack propagation. Thermal aging further reduced resistance to stress corrosion. The temperature dependence of solid solubility of N in Types 304, 308, and 384 stainless steels was determined. (P.G.C.)

43532 PROTECTION AGAINST CORROSION BY METAL FINISHING. Proceedings of the International Conference, Basel, 22–25 November 1966. Oesterle, K. M.; Saboz, A. L. (eds.).

Zurich, Forster-Verlag AG, 1967. 358p. (In several languages). (CONF-661138).

Forty-seven papers were presented at the conference. A separate abstract was prepared for four of the papers. Papers for which no abstracts were prepared are concerned with surface protection of substrates by metals and their compounds and with methods and results of surface protection of substrates by organic coatings. (P.G.C.)

For abstracts of individual papers see: 43549, 43550, 43563, and 43636.

43533 COMPATIBILITY OF MATERIALS WITH ALKALI METALS FOR SPACE NUCLEAR POWER SYSTEMS. Harms, W. O.; Litman, A. P. (Oak Ridge National Lab., Tenn.). Nucl. Appl., 5: 156-72(Sept. 1968). (ORNL-P-3725).

The metals lithium, potassium, and cesium are of principal interest as heat transfer and working fluids in high-performance space-nuclear reactors employing single- and multiloop Rankine cycle conversion. The compatibility of these alkali metals with structural alloys has been investigated for more than a decade in both laboratory and engineering-scale tests. It is demonstrated that reliable engineering systems involving potassium and cesium can be constructed and operated at 2000°F with first-generation niobium-base alloys like Nb-1% Zr and at 2200°F with advanced niobium-base alloys. Niobium-base alloys can be used at higher temperatures in lithium systems. Tantalum-base alloys appear to be satisfactory for potassium or cesium to at least 2200°F and probably a few hundred degrees higher with lithium. Very advanced systems designed for temperatures of 2500°F and higher probably will require a new group of alloys; tungsten-base alloys appear to be strong candidates for these applications. (auth)

43534 HIGH TEMPERATURE OXIDATION OF AN Fe-Cr-Al-Y ALLOY IN CO_2. Francis, J. M.; Jutson, J. A. (Central Electricity Generating Board, Berkeley, Eng.). Corros. Sci., 8: 445-9(June 1968).

The structure and composition of thin oxide films formed during high temperature oxidation of an Fe-15% Cr-4% Al-1%Y alloy in CO_2 are reported. Over the exposure period 0.1 to 1000 hr the rate-controlling step is attributed to self-diffusion of Al^{3+} in Al_2O_3. No other phase contributes significantly to the oxidation behavior of this alloy, apart from Y_2O_3, which apparently enhances scale adhesion. (auth) (UK)

43535 STUDY OF THE TRANSFER OF CARBON THROUGH MOLTEN SODIUM FROM UNSTABILIZED TO STABILIZED AUSTENITIC STAINLESS STEEL. Borgstedt, Hans Ulrich (Kernforschungszentrum Karlsruhe, Ger.). Corros. Sci., 8: 405-12(June 1968). (In German).

In static corrosion tests in Na at 600 to 700°C a transfer of C took place between the unstabilized steel (× 5) 18 Cr-9 Ni and the stabilized steel (× 8) 16 Cr-13 Ni-Mo-V-Nb. The stabilized steel was embrittled in a zone of up to 100 μm depth after 1000 hr at 700°C. Microprobe analysis showed that embrittlement was accompanied by an enrichment in C. On the surfaces of the specimens a corrosion layer formed which was rich in carbon, but also contained Na and O. (auth) (UK)

43536 OXIDATION-RESISTANT COATINGS FOR REFRACTORY METALS. Allen, B. C. (Battelle Memorial Inst., Columbus, Ohio). DMIC Rev., 3p(July 26, 1968).

A brief summary of recent developments in the technology of forming oxidation resistant coatings on W, Nb-Ta alloys, and Mo alloys. Methods for applying coatings, process variables, and mechanical properties are discussed. Eight references. (P.G.C.)

43537 ZASHCHITA VOL'FRAMA OT OKISLENIYA PRI VYSOKIKH TEMPERATURAKH. (Protection of Tungsten Against High-Temperature Oxidation). Ivanov, V. E.; Nechiporenko, E. P.; Efimenko, L. N.; Yurchenko, M. I. Moscow, Atomizdat, 1968. 160p.

Aspects of various measures for tungsten protection against high-temperature corrosion are briefly reviewed. High-resistance of coating materials is discussed and characteristics and properties of various alloying materials (Mo, Nb, Zr, Re, Ta and C) and their effects on W mechanical and corrosion properties are analyzed. Data obtained showed that coating with ThO_2, HfO_2, ZrO_2 and other complex oxides makes tungsten usable as construction material at 2000 to 3000°C. Experiments with porous tungsten saturated with Ag and similar materials indicated a promising future for such material use at 3000°C. 357 references. (R.V.J.)

43538 SCALING AND INTERGRANULAR OXIDATION OF AN Fe/48 wt. PERCENT Ni ALLOY IN CARBON DIOXIDE AT 700 TO 1000^0C. Menzies, I. A.; Tomlinson, W. J. (Univ. of Manchester, Eng.). J. Mater. Sci., 2: 529-37(Nov. 1967).

The oxidation of Nilo 48 was studied using thermogravimetric, metallographic, and electron probe microanalysis techniques at 700 to 1000°C. After a short period of ill-defined oxidation, the parabolic law was obeyed throughout the exposure period, which varied from ~1050 hr at 713°C to 50 hr at 1000°C. The activation energy for the oxidation reaction was 48 ± 6 kcal/mole. Examination of the external scale indicated that this was single phase and, at 1000°C, its composition corresponded to $Ni_xFe_{3-x}O_4$, where $x \leq 0.4$. There were also intergranular oxidation and nickel enrichment of the alloy underlying the external scale. After oxidation for only 10 min at 1000°C, the nickel-enriched alloy zone contained 65 wt % Ni. The manganese concentration in the scale was similar to that in the alloy. The results are discussed and compared with those of other workers, and it is concluded that the rate-controlling process is the diffusion of iron through the $N_xFe_{3-x}O_4$ lattice. (auth) (UK)

Preparation and Fabrication

Refer also to abstracts 42952 and 44896.

43539 (CEND-3742-336) VANADIUM PURIFICATION. Sixth Quarterly Progress Report, January 1-March 31, 1968. Wang, C. T.; Barock, E. F.; La Vake, J. C.; Christopher, S. S. (Combustion Engineering, Inc., Windsor, Conn. Nuclear Power Dept.). Apr. 1968. Contract AT(30-1)-3742. 43p. Dep. CFSTI.

A 100-pound high-purity V-15Cr-5Ti alloy ingot was produced with a total interstitial content of less than 400 ppM. The process developed for the production of the alloy ingot was as follows: aluminothermic reduction of V_2O_5; consolidation by electron beam melting of the reduced vanadium derbies; double electron beam melting; compaction of vanadium, titanium and chromium flakes and chips; and double arc melt, first in argon, then in vacuum. (auth)

43540 (LA-3937) ENCAPSULATION OF PLUTONIUM AND OTHER RADIOACTIVE MATERIALS IN WELDED CONTAINERS. Anderson, J. W.; Nichols, J. R. (Los Alamos Scientific Lab., N. Mex.). Apr. 1968. 10p. Dep. CFSTI.

In connection with the charging and sealing of plutonium alloy into fuel capsules for LAMPRE (Los Alamos Molten Plutonium Reactor Experiment), production equipment and a procedure have been developed that have general application. Radioactive or other noxious materials are loaded into cylindrical containers without contaminating the outside of the containers, an inert atmosphere is provided, and the containers are welded shut. The equipment consists of a welding fixture, atmosphere controls, and a power supply. The procedure depends on careful handling and the convenience of the equipment. (auth)

43541 (RD/B/N-1013) PRECIPITATION OF ALUMINIUM FROM SUPERSATURATED SOLUTION IN ALPHA URANIUM. Smith, A. F. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). May 1968. 13p. Dep.

The kinetics of the formation of precipitates from γ quenched adjusted uranium were studied by lattice parameter changes. It was established metallographically and by electron microscopy that only the phase UAl_2 precipitates on heating in the α phase. In the temperature range examined (350 to 600°C), the kinetics of precipitation are consistent with the nucleation and growth of precipitates on subgrain boundaries and on individual dislocations within subgrains. (auth) (UK)

43542 (TRG-Report-1523) A NOMOGRAM FOR THE PREDICTION OF EXTRUSION PRESSURES IN THE SIMPLE HYDROSTATIC EXTRUSION OF ROUND BAR THROUGH CONICAL DIES. Thompson, P. J.; Daniels, P. R. C. (United Kingdom Atomic Energy Authority, Springfields (England). Reactor Group). Nov. 14, 1967. 19p. Dep. CFSTI. UK 3s. 0d.

Some of the extrusion results obtained on the Fielding and Platt 200/50 'HYDROSTAT' at Springfields were used to construct a nomogram. This diagram enables the pressures for round-to-round extrusion through conical dies to be predicted from an equivalent stress-strain diagram produced from the results of a simple compression test performed on each material to be extruded. The results obtained from the nomogram indicate that the assumptions made in its construction are sufficiently valid to give first-order predictions of extrusion pressures. (auth) (UK)

43543 (WCAP-3374-7-P) EVALUATION OF ZIRCALOY-STAINLESS STEEL METALLURGICALLY BONDED JOINTS. Marti-Balaguer, L.; White, J. K. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Oct. 1964. Contract AT(30-1)-3374. 37p. Dep. CFSTI.

Various nondestructive test methods were investigated for suitability for detecting unbonded areas in Zircaloy-stainless steel transition joints. Ultrasonic testing was found to be the preferred method. Destructive and nondestructive tests were performed on metallurgically bonded Zircaloy-4 to type 316 stainless steel joints. Tension testing of a full-size joint at 688 to 723°F demonstrated that the transition joint is capable of sustaining as much stress as an all-Zircaloy assembly. Cold working of joints to improve the mechanical properties of Zircaloy-4 was accomplished without damage to the diffusion bond in three out of six attempts. In the other three attempts, separation of the diffusion bond occurred over small areas of each joint. (auth)

43544 (Y-1625) METALLOGRAPHIC EXAMINATION OF POROUS MATERIALS. Doney, L. M.; Holcombe, C. E.; Avant, H. S. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). July 30, 1968. Contract W-7405-eng-26. 15p. Dep. CFSTI.

Specimens of porous materials as Be, W, carbon foam, and ceramics, are prepared for photomicrography by standard metallographic techniques after impregnating with a low-melting point alloy, such as Cerrobend, to prevent mechanical pullout. (P.G.C.)

43545 ELECTRON BEAM MELTING OF TUNGSTEN. Amos, J. C. E.; Morton, P. H. (Imperial Metal Industries, Ltd., Birmingham, Eng.). Rev. Int. Hautes Temp. Refract., 5: 141-4 (Apr.-June 1968).

The peculiar problems encountered during the melting of tungsten by electron bombardment, and which do not exist for refractory metals like Nb, Ta, and their alloys, are described. The effect of the parameters of melting on the elimination of interstitial impurities, and also the effect of the amount of impurities on the rate of the melting, are discussed. Special precautions must be taken when preparing the electrodes to avoid cracks. A new design of the hearth is used to avoid cracking due to thermal shock at the beginning of the melting. Ingots of a diameter of 6.5 cm have been melted with a 260-kW furnace. (auth)

43546 IMPROVEMENTS IN OR RELATING TO COMPACTION PROCESSES. Butcher, John William (to United Kingdom Atomic Energy Authority). British Patent 1,118,003. June 26, 1968. Filed Apr. 14, 1965.

Addition of Si, in the form of −400 mesh powder or a silane, as an activator to subsieve Be powders provided a barrier to the formation of metal-metal bonds between the particles but promoted diffusion of Be through the film at sintering temperatures. Hot pressing at temperatures below 1100°C produced compacts having a density of 100% of theoretical. (P.G.C.)

43547 STUDIES ON THE METALLO-THERMIC PREPARATION OF MISCHMETAL. Ranganathan, T. N.; Singh, A. J.; Abubacker, K. M. (Atomic Energy Establishment, Bombay). Trans. Indian Inst. Metals, 20: 41-4(Mar. 1967).

Laboratory scale experiments on the preparation of mischmetal by the calcio-thermic reduction of mixed rare earth fluorides have shown that good slag-metal separation is possible when anhydrous ferric chloride is incorporated in the charge as a thermal booster. Mischmetal yields of about 75 to 80% have been obtained in kilogram scale reductions carried out in refractory lined steel bombs. (auth)

43548 CALCIOTHERMIC REDUCTION OF NIOBIUM PENTACHLORIDE. Surana, V. S. (Hindustan Aluminium Corp., Mirzapur, India); Jena, P. K. Trans. Indian Inst. Metals, 20: 60(Mar. 1967).

Production of Nb metal by bomb reduction of $NbCl_5$ with Ca and S is reported. Physical tests and microstructure indicate presence of considerable amounts of impurities even after arc melting. (P.G.C.)

43549 DEPOSITION OF Nb, Ta, Mo, AND W BY REDUCTION OF THE CORRESPONDING CHLORIDE WITH Zn VAPOR. Brossa, F.; Schleicher, H. W.; Venker, H. (Euratom, CCR, Ispra). pp 148-50 of Protection Against Corrosion by Metal Finishing. (In German).

From International Conference on Protection Against Corrosion by Metal Finishing, Basel, Switzerland. See CONF-661138.

To deposit metals on ceramic and metallic materials, the volatile chlorides ($NbCl_5$, WCl_6, $MoCl_5$, $TaCl_5$) were reduced in the gaseous phase with zinc and cadmium at temperatures between 500 and 700°C. At such temperatures Cd and Zn have a vapor pressure of between 1 and 300 torr, which allows the reaction to be carried out in a vessel evacuated to a pressure of this order, in the case of niobium deposition according to: $2\ NbCl_5 + 5\ Zn \rightarrow 2\ Nb + 5\ ZnCl_2$. The zinc and cadmium halides that are thereby produced are also volatile and can be sucked off. Deposition of the less volatile subchlorides of the related transition metals was not observed in the case of Nb, W or Ta. The tests with Mo have not been concluded yet. Compared with the reducing agents used in the Kroll process, the advantage of using zinc and cadmium is that, except for the metal to be deposited, all the elements involved in the reaction are in vapor form and do not contaminate the metal obtained. Two variants of the process have been tried out under practical conditions. In the first method zinc and niobium pentachloride were evaporated in separate vessels and, using argon as carrier gas, were conveyed into a reaction chamber at 600°C, where a coating of niobium formed on ceramic and metallic workpieces. In the second method a mixture of coarse zinc powder with chlorides of the metals to be deposited was allowed to fall directly into the reaction chamber; the zinc and chlorides evaporate in the chamber and the metal formed is deposited on the walls of the vessel and specimens in the chamber. The latter arrangement is particularly suitable for the deposition of alloys, as a mixture containing different halides can be used. The coatings obtained were homogeneous with a specular surface finish. (auth)

43550 DIFFUSION COATING METALS IN MOLTEN FLUORIDE BATHS. Cook, N. C. (General Electric Research and Development Center, Schenectady, N. Y.). pp 151-5 of Protection Against Corrosion by Metal Finishing.

From International Conference on Protection Against Corrosion by Metal Finishing, Basel, Switzerland. See CONF-661138.

Metal alloy protective coatings, including intermetallic compounds, solid solutions, and plates, are prepared by use of molten alkali and alkaline earth fluorides as solvents in an electrolytic process operated between 600 and 1200°C in an inert atmosphere. The process is adapted to continuous operation. (P.G.C.)

43551 R-F SPUTTERING PROCESSES. Vossen, J. L.; O'Neill, J. J. Jr. (RCA Labs., Princeton, N. J.). RCA Rev., 29: 149-79(June 1968).

RF sputtering, which has been found useful as a technique for both film deposition and nonchemical etching of a wide range of materials, is highly dependent upon the configuration of the sputtering equipment. An apparatus was designed after consideration of all aspects of the process — the sputtering mechanism, the rf discharge, the rf circuitry, the vacuum system, and the general ease of operation and maintenance. The system parameters that control deposition rates and etch rates were studied. Based on the results of this study, deposition and etch rates can be controlled within ±2% on a routine basis. In general, metals have the highest sputtering rates, complex crystalline solids have the lowest sputtering rates, and glasses and simple crystalline solids have intermediate sputtering rates. The quality of deposited films depends to a large extent upon the deposition rate. The maximum deposition rates that yield films of high quality range from a few tens of Å/min to about a thousand Å/min, depending upon the material being deposited. As a deposition process, the main advantage of rf sputtering is its versatility. In theory, any material can be sputtered using this technique. However, certain phenomena occurring at the target surface and on the substrate may tend to change the stoichiometry of materials. Specifically, crystalline oxides of low chemical bond strength can be reduced chemically by argon discharges. Eighteen different oxides were studied experimentally, resulting in a tabulation that can be used to determine whether chemical reduction will occur in a given material. Changes in stoichiometry can also occur as a result of sublimation from the target and/or substrate when one of the constituents is highly volatile. This has been investigated empirically using the system $Cd_xNb_2O_{5+x}$ as a vehicle. For etching, the main advantages of the rf sputtering process are (1) any solid material can be etched; (2) etch rates are easily controlled; (3) the technique produces etched patterns with vertical walls to a definition limited only by the mask used. To produce patterns of this type and to retain the original surface character, etch rates similar to the deposition rates cited above must be used. (auth)

43552 INJECTION CASTING ALUMINUM–10 WT. PERCENT PLUTONIUM FUEL ELEMENTS. Miller, G. E. (Battelle-Northwest, Richland, Wash.). Nucl. Appl., 5: 68-73(Aug. 1968).

Eight hundred fifty aluminum–10 wt % plutonium alloy fuel rods containing ~55 kg of plutonium were fabricated by an injection casting process and encapsulated in Zircaloy-2 tubing. Casting was accomplished by inserting one end of a 0.610-in. ID by 42-in. long pyrex glass mold into the molten alloy and then evacuating the mold. The diameter of the cast rods was 0.600 in. ± 0.001 in. with an average length of 38 in. Each element contained two or more of the fuel rods, totaling 47.75 in. in length. Unheated pyrex molds produced higher quality castings than unheated mild steel molds, heated pyrex molds, or heated mild steel molds. Plutonium melt homogeneity was significantly improved by changing from intermittent melt stirring to continuous melt stirring prior to casting. (auth)

43553 METALLOGRAPHIC TECHNIQUES FOR OBSERVATION OF JOINTS BETWEEN DIFFERENT MATERIALS MAINLY OF NUCLEAR INTEREST. Bassi, A.; Be, C. A.; Camona, G. (CISE, Milan). Energ. Nucl. (Milan), 15: 532-43(Aug. 1968).

A brief review is given of metallographic techniques used to study the morphology of joints between different materials. Results of examinations are presented for joints made by temperature effect only, by a combination of temperature and stress, and by conventional welding. Materials used in the joints include Fe, Cr, Si, Mo, Ni, stainless steel, Zircaloy-2, SAP, Nb, TD nickel, soft iron, Ti, Monel, Inconel, U, steel, W, and Ta. The etching solutions used are listed. (D.L.C.)

43554 NEW TECHNIQUE FOR THE PRODUCTION OF FIBRES OF TUNGSTEN. Prasad, P. M.; Misra, Somnath (Banaras Hindu Univ., India). Trans. Indian Inst. Metals, 20: 241-2(Dec. 1967).

Starting with an organic fibrous substrate, such as the cotton rope, soaked in a saturated solution of tungstic acid in ammonia, it has been possible to produce fibrous products of tungsten by charring, ignition and reduction at suitable temperatures. Under the conditions employed herein, the products were fragile but they can be strengthened by reduction or sintering at suitably high temperatures. (auth)

43555 IMPROVEMENTS IN OR RELATING TO FERROUS ALLOYS. Aldersley, Kenneth; Martin, Alfred John; Wakelin, Richard John (to United Kingdom Atomic Energy Authority). British Patent 1,122,903. Aug. 7, 1968. Filed May 26, 1966.

An iron-base-copper-nickel alloy was developed which is age-hardenable in the martensitic state. Properties are similar to the maraging steels which contain more expensive metals such as nickel, molybdenum, or cobalt. Incidental elements such as aluminum, silicon, beryllium, tantalum, titanium, or zirconium may be added in small proportions as hardeners. (P.G.C.)

43556 KINETICS OF THE CHLORINATION OF TANTALUM-PENTOXIDE WITH CHLORINE IN PRESENCE OF EXCESS OF GRAPHITE POWDER. Mehra, O. K.; Jena, P. K. (Bhabba Atomic Research Centre, Bombay). Trans. Indian Inst. Metals, 20: 210-12(Dec. 1967).

Kinetics of the chlorination of tantalum pentoxide pellets by chlorine in presence of excess of graphite powder has been studied. The effect of surface area of the pellet, temperature of chlorination, flow rate and partial pressure of chlorine (p_{Cl_2}), has been investigated. The amount chlorinated was found to be directly proportional to the time of reaction and surface area of the pellet. The rate of chlorination was proportional to $p_{Cl_2}^{1/2}$ and was independent of flow rate of Cl_2 in the range studied. The activation energy of the process has been found to be 31 k.cal/mole. A probable mechanism of the chlorination process, based on absolute reaction rate theory, has also been suggested. (auth)

43557 PREPARATION OF ZIRCONIUM METAL POWDER BY CALCIOTHERMIC REDUCTION OF ZIRCONIUM OXIDE. Sundaram, C. V. (Bhabha Atomic Research Centre, Bombay); Ray Chaudhuri, P. K.; Raman, L. V. P.; Krishnan, T. S. Trans. Indian Inst. Metals, 20: 187-90(Dec. 1967).

Results are presented from investigations on the preparation of micron size zirconium metal powder by calcio-thermic reduction of zirconium oxide, in the presence of $CaCl_2$ (added as heat-sink to prevent sintering). The influence of variables such as initial particle size of ZrO_2, proportion of calcium excess and $CaCl_2$ in the charge, and temperature of reduction has been studied to arrive at the optimum conditions. A metal powder yield, over 90% of theoretical, and predominantly 2μ size, has been obtained at 950°C with −325 mesh ZrO_2, a calcium excess of 50% and ½ mole of $CaCl_2$/mole of oxide in the charge. The powder is intended for use in ignition compositions in photoflash bulbs and as a "getter" in vacuum technology. (auth)

43558 METALLOGRAPHIC INVESTIGATION OF ZIRCONIUM FUSED ON GRAPHITE. Kravetskii, G. A.; Posos'eva, G. D. Svar. Proizv., No. 2, 15-17(1968). (In Russian).

A zirconium coating 4.0 to 5.5 mm thick was fused onto graphite by arc welding with a nonconsumable electrode in an argon atmosphere using zirconium wire 3 mm in diameter fed at a rate of 20 to 260 mm/min, at a current of 400 to 450 amp at 27 to 33 V, and at a welding speed of 200 to 220 mm/min. Under these conditions, the metal was deposited at a rate of 5 to 6 kg/hr in beads 15 to 20 mm wide and 4.0 to 5.5 mm high. An examination of the coated specimens revealed a 2 to 5 mm-thick zone of zirconium-impregnated graphite topped with a dense zirconium carbide film 0.02 to 0.04 mm thick. On top of the film was a layer of weld metal with the structure of cast zirconium. The weld metal surface had a thin oxide film with an outer layer 0.1 to 0.15 mm thick enriched with oxygen and nitrogen. The microstructure and properties of the fused-on weld were found to depend on its contamination with oxygen, nitrogen, and carbon, on the kinetics of the $\alpha \rightarrow \beta$ zirconium transformation, and on the redistribution of dissolved impurities. Because of the greater amount of impurities present in the weld metal in arc facing with local (argon jet) protection of the molten metal bath, hard thin flakes of α-phase zirconium were formed in the weld metal, which made machining of the coating difficult. Depending on the conditions of arc facing in the chamber with an argon atmosphere, the fused-on zirconium had either a structure of the α-phase with nonuniformly distributed impurities, or a martensitic-type structure of the α-phase. (ATD)

43559 DEEP DRAWING OF MOLYBDENUM AND ITS ALLOYS. Korolev, V. N.; Shofman, L. A. Kuznechno-Shtampovochnoe Proizvod., No. 10, 17-23(1967). (In Russian).

The effect of various factors on the capacity for deep drawing of commercial-grade sintered molybdenum and TsM-2 and Vm-1 molybdenum alloys has been investigated on flat specimens, 6 mm wide and 0.5 and 0.8 mm thick, cut from rolled sheets in the direction along, and/or transverse, or at a 45° angle to the direction of rolling. Test specimens in the annealed or strain-hardened condition were tested for mechanical properties under conditions of uniaxial and biaxial tension at temperatures up to 500°C. Except for recrystallized sheet, the NDT temperature of all the investigated materials was below room temperature. This showed that satisfactory parts can be produced from them by drawing at room temperature. The capacity for deep drawing depended mainly on the content of impurities, the microstructure and the deformation rate. Heating to 100 to 120°C significantly decreased the susceptibility to exfoliation and cracking and appreciably extended the use of the investigated metals. Static uniaxial tension tests did not adequately reveal the capacity of molybdenum sheet for deep drawing because of the anisotropy of mechanical properties in the sheet plane, and because of different behavior of molybdenum at linear and plane modes of the stressed state. The capacity for deep drawing was satisfactorily characterized by biaxial static tension tests with a fluid (in burst tests) or a rigid punch. This can be explained by the higher susceptibility of molybdenum to tensile tangential stresses at room temperature. The capacity of sheet molybdenum for deep drawing increased with increasing (to 70 to 90%) prestraining at cold or warm rolling. The experimental results showed also the feasibility of progressive multioperation deep drawing of thin wall parts from molybdenum and molybdenum-alloy sheets, with or without intermediate stress relieving. Depending on the sheet thickness, the direction of rolling and the heat treatment prior to drawing, the optimum temperature of drawing was within 220 to 350°C. (ATD)

43560 PRODUCTION AND TESTING OF WELD SEAMS. (to Siemens-Schuckertwerke Aktiengesellschaft). British Patent 1,118,104. June 26, 1968. Priority date June 11, 1965, Germany.

Circular weld seams on the end caps of reactor fuel rods are produced by rotating the casing tube about its axis, so that the weldment moves adjacent to the welding electrode, and continuously irradiating the weld by focused x-ray beams which are received by a detector producing electrical signals to indicate the quality of the weld seam. The radiation source and detector are rigidly interconnected but may be adjusted to follow the configuration of the work piece. Irradiation may also be produced by neutron sources or radioactive isotopes. (P.G.C.)

43561 STABILITY OF TUNGSTEN AND THORIA DISPERSION IN BERYLLIUM. Watts, C. R. (Aerospace Corp., El Segundo, Calif.). Int. J. Powder Met., 4: 49-53(July 1968).

Mixtures of tungsten or thoria with beryllium powder were prepared by the decomposition of ammonium metatungstate or thorium nitrate under hydrogen after precipitation from an aqueous solution containing the powder. As the hot-pressing or sintering temperature for the compositions containing tungsten was raised above 750°C, the tungsten reacted to produce WBe_{12}. As the temperature was raised above 850°C, WBe_{22} began to form. Above 1100°C, WBe_{22} was the only beryllide present. The reactions were apparently irreversible. The dispersions of thoria reacted above 750°C to produce $ThBe_{13}$ as the dispersed phase. No other thorium beryllides were produced or expected at higher consolidation temperatures. (auth)

43562 DYNAMIC COMPACTION OF METAL POWDERS WITH A HIGH VELOCITY IMPACT DEVICE. Hagemeyer, J. W.; Regalbuto, J. A. (General Dynamics Corp., Fort Worth, Tex.). Int. J. Powder Met., 4: 19-25(July 1968).

A small, cartridge-actuated press is described which was used to compact unheated metal powders by impacting them in an evacuated die at velocities between 500 and 1100 feet per second. Density and hardness data are given for 16 different materials which were compacted in this device to greater than 90% of their theoretical values. The impact conditions which produced satisfactory compacts from each material are given. Typical microstructures of green compacts produced by this technique are shown. The best quality compacts resulted from the use of powders composed of very fine, nonspherically shaped particles. (auth)

43563 EMERGENCE OF CHEMICAL VAPOR DEPOSITED COATINGS FROM LABORATORY TO COMMERCIAL APPLICATION. Holzl, R. A. (San Fernando Labs., Pacoima, Calif.). pp 142-7 of Protection Against Corrosion by Metal Finishing.

From International Conference on Protection Against Corrosion by Metal Finishing, Basel, Switzerland. See CONF-661138.

An abbreviated review of the chemical vapor process for applying protective metal coatings and some of the principal applications is given with a discussion of claddings of particular interest, properties, performance, economics and the current state of the art. (P.G.C.)

Properties Evaluations

Refer also to abstracts 44876 and 44926.

43564 (BNL-50115) HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW. A Bimonthly Technical Progress Review. Volume 6, Number 2. (Brookhaven National Lab., Upton, N. Y.). Apr. 1968. 88p. Dep. CFSTI.

A review of progress from July 1967 to April 1968 in research and development programs bearing on high-temperature liquid metal technology is presented. Includes evaluation of liquid metals, thermophysical properties of Na, tests of K turbines, tests of stainless steel cladding, development of Na-heated steam generators, space programs, heat transfer, fluid mechanics, and cavitation phenomena. (P.G.C.)

43565 (COO-841-15) DIFFUSION STUDIES IN LIQUID METALS. Progress Report, May 16, 1967-June 15, 1968. Swalin, R. A. (Minnesota Univ., Minneapolis. Inst. of Tech.). Contract AT(11-1)-841. 20p. Dep. CFSTI.

SODIUM—diffusion at constant volume of liquid, self-; radial distribution function of liquid, x-ray diffraction
NICKEL—diffusion in liquid silver
FURNACES—design for thermal diffusion experiments using liquid silver
SODIUM, POTASSIUM, RUBIDIUM—electric conductivity of liquid, experimental and theoretical (D.L.C.)

43566 (EUR-3929) NON-DESTRUCTIVE AND DESTRUCTIVE TESTING OF REACTOR PRESSURE TUBES IN SAP. Albertini, C.; Montagnani, M.; Weltevreden, P. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1968. 44p. (CONF-671061-1). Dep.

From 4th Congress on Testing of Materials, Budapest, Hungary.

A selection of SAP reactor pressure tubes was evaluated by destructive and non-destructive test methods. Non-destructive methods included dimensional measurement, visual examination by boroscope, fluorescent penetrant, ultrasonic, and x-ray testing. Tensile tests at 420°C were made as were chemical and activation analyses, creep and residual stress tests. A statistical evaluation of creep rupture data obtained at 420 to 450°C and 10,000 and 100,000 hrs. is given. (P.G.C.)

43567 (IS-1860) THRESHOLDLESS CONVECTION IN LIQUID METAL DIFFUSION COEFFICIENT MEASUREMENTS. Verhoeven, J. D. (Ames Lab., Iowa). Aug. 1968. Contract W-7405-eng-82. 13p. Dep. CFSTI.

Horizontal density gradients may arise in the capillary tubes used to measure liquid metal diffusion coefficients as a result of cyclic temperature control. Such gradients will produce natural convection of the metal in the capillary tube. An approximate analysis has been carried out to determine the magnitude of the error which such convection would produce in the measured values of the diffusion coefficients. The results indicate that the errors would be negligibly small in liquid metal systems but might be appreciable in systems having smaller thermal diffusivities. (auth)

43568 (N-68-13631) GENERATION OF LONG TIME CREEP DATA ON REFRACTORY ALLOYS AT ELEVATED TEMPERATURES. Sawyer, J. C.; Sheffler, K. D. (TRW Equipment Labs., Cleveland, Ohio. Materials Research and Development Dept.). Aug. 1, 1967. Contract NAS3-9439. 51p. (NASA-CR-72319). CFSTI.

Molybdenum-base TZC and TZM alloys and tantalum-base T-111 and Astar 811C are being creep tested in a vacuum environment of 1×10^{-8} torr. Test temperatures range from 1600 to 2600°F and stresses from 0.5 to 65 Ksi. Test parameters were selected to provide 0.5–1.0% creep in 5,000 to 15,000 hours. Test results with molybdenum-base TZC and TZM show the effects of variations in chemistry and method of processing. Tests with tantalum-base T-111 reveal that significant variations in creep strength can occur between heats of materials. Data are presented to suggest that low creep strength of T-111 alloy may be the result of fine grain size. Comparison of tantalum-base Astar 811C with T-111 shows the superior creep properties of the Astar 811C alloy. (auth) (STAR)

43569 (RD/B/N-1009) THE MECHANISM OF VOID GROWTH AND FACTORS AFFECTING THE ONSET OF INTERGRANULAR FAILURE DURING CREEP OF MAGNOX AL80. Evans, H. E. (Central Electricity Generating Board, Bristol (England). Berkeley Nuclear Labs.). Feb. 1968. 23p. Dep.

Tensile tests on Magnox AL80 were conducted at a strain rate of $10^{-2}hr^{-1}$ over the temperature range 25 to 400°C and grain size range 0.009 to 0.300 in. It is shown that the growth of voids occurs by a grain boundary sliding mechanism, and the variation of ductility in the intergranular failure range is interpreted by means of this parameter. The factors which lead to the onset of intergranular failure are discussed in terms of the relative ease of nucleation, and rate of growth of intragranular cracks and grain boundary cavities. (auth) (UK)

43570 (RD/B/N-1050) APPLICATION OF FRACTURE MECHANICS TO FATIGUE CRACK GROWTH. Formby, C. L. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). May 1968. 11p. (JNPC-SSG/P-(68)-46). Dep. CFSTI.

Fracture mechanics is applied to Stage II crack propagation in fatigue, emphasis being put on the ranges of usefulness of the stress intensity factor, K, in correlating results from different crack configurations. In repeated tension this simple correlation is valid except when the specimen is very small, when plastic blunting of the crack tip is important, or when the crack is close to instability and the stress high. The stress range over which it can be applied in push-pull fatigue is very limited. A more exact treatment is derived for this, but it can be applied to a few configurations only. The effect on fatigue of pressure vessel bulging is briefly discussed. (auth) (UK)

43571 (TID-24570) THERMALLY ACTIVATED DEFORMATION OF α-ZIRCONIUM AND α-ZIRCALOY. LWBR/LSBR Development Program. Hull, J.; Conrad, H. (Franklin Inst. Research Labs., Philadelphia, Pa.). Aug. 1967. Contract AT(11-1)-Gen-14; Subcontract 73-14-1236. 89p. (F-C-1834). Dep. CFSTI.

For Bettis Atomic Power Lab., West Mifflin, Pa.

The dislocation mechanism associated with the deformation dynamics of α-zirconium and Zircaloy at low temperatures (below 600°F) was evaluated from data available in the literature using the thermal activation analysis and Fleischer's model for solute hardening. It was established that this mechanism in both the unalloyed zirconium and in Zircaloy was the overcoming of interstitial impurity atom barriers by thermally activated dislocations moving on the first order prism planes, similar to titanium. However, the flow stress in zirconium and Zircaloy was proportional to the interstitial impurity concentration, in contrast to titanium where it varies with the square root of the concentration. It is felt that this is due to the fact that the lattice distortions associated with the major interstitial atom—oxygen—are nearly symmetrical in zirconium, whereas they are asymmetrical for titanium. The activation energy, and the frequency of thermal fluctuations associated with this mechanism of short range interactions in zirconium and Zircaloy are 1.37 eV (0.21 μb^3), and 5×10^8 sec^{-1}, respectively. At low temperatures (below 600°F) it appears that radiation produces hardening, the exact nature of which is not clear. At high temperatures (above 1100°F), irradiation has only a limited significance because of the effective annealing out of radiation induced defects. The effect at intermediate temperatures may produce either a hardening or softening (decrease or increase in creep rate) depending on metallurgical structure, the deformation rate, the temperature and the irradiation flux. (P.G.C.)

43572 (UCRL-71029) CONTAMINATION OF REACTIVE METALS IN VACUUM HEAT TREATING AT VARIOUS VACUUM LEVELS. Bunshah, R. F. (California Univ., Livermore. Lawrence Radiation Lab.). July 5, 1968. Contract W-7405-eng-48. 16p. (CONF-680623-1). Dep. CFSTI.

From Vacuum Metallurgy Conference, Beverly Hills, Calif.

During a vacuum exposure at 4×10^{-6} torr at 1800°C, significant contamination of tantalum with oxygen occurs in a short time. Contamination by carbon, nitrogen, and hydrogen is minor or negligible. During a vacuum exposure at 2×10^{-10} torr and 1400°C, there is no measurable contamination of tantalum. Tungsten is not contaminated over the pressure range 4×10^{-6} to 2×10^{-10} torr, presumably because of a dynamic balance between the contaminating and purifying reactions. Tantalum foil is an excellent passive monitor of the contamination during a long vacuum exposure. It should be included routinely in long creep exposures and analyzed for O, N, H and C after exposure. (auth)

43573 (WAPD-Trans-0094) PROTECTION OF ZIRCONIUM AGAINST OXIDATION BY MEANS OF METALLIC COATINGS. Baque, P.; Darras, R.; Lafon, A.; Loriers, H. Translated for Bettis Atomic Power Lab., West Mifflin, Pa., from J. Nucl. Mater., 25: 166-71(1968). 14p. Dep. CFSTI.

This paper was abstracted from the original language and appeared in NSA as 22: 17123. (J.R.D.)

43574 METALLURGIYA YADERNOGO GORYUCHEGO. SVOISTVA I OSNOVY TEKHNOLOGII URANA, PLUTONIYA, I TORIYA. (Nuclear Fuel Metallurgy. Uranium, Plutonium, and Thorium: Properties and Technology). Emel'yanov, V. S.; Evstyukhin, A. I. Moscow, Atomizdat, 1968. 484p.

A brief review is given on properties, preparation and uses of U and Pu isotopes. Mining methods and uranium and plutonium ore extraction are described. Theoretical data are given on hydrometallurgy and pyrometallurgy of these metals, their alloys and high-melting point compounds. Separation of uranium isotopes and methods for plutonium separation from irradiated fuel elements and purification of Pu from U and fission products are discussed. Technology of metals, ceramics, and U- and Pu-enriched dispersion nuclear fuel is reviewed. Data are given on radioresistance and efficiency of nuclear fuel elements. The burnup problems and nuclear power plant economic aspects are also analyzed. The preparation, treatment, and properties of new compounds of uranium, plutonium, and thorium carbides and nutrides are described. 572 references are given. (R.V.J.)

43575 A CONTINUOUS COMPILATION OF NEW REFERENCE DATA ON DIFFUSION PROCESSES IN INORGANIC SOLIDS AND THEIR MELTS. Diffus. Data, 2: 103-245(Aug. 1968).

A compilation of new reference data on diffusion processes in inorganic solids and their melts is presented. The temperature and pressure ranges over which the data are applicable are given, as well as information on the experimental methods employed for their determination. The purity and properties of the materials used is also described. The data are arranged in the following order: diffusion in solid metals and alloys; diffusion in liquid metals; diffusion in intermetallic compounds; diffusion in oxides, oxide minerals, and glasses; diffusion in halides; and diffusion in miscellaneous substances. Lists of references to new and previously published articles on diffusion processes are included. (R.C.K.)

43576 THERMAL EXPANSION OF POLYCRYSTALLINE TITANIUM AND ZIRCONIUM. Cowan, J. A.; Pawlowicz, A. T.; White, G. K. (Commonwealth Scientific and Industrial Research Organization, Sydney). Cryogenics, 8: 155-7(June 1968).

Observations of thermal expansion made between 2 and 30°K differed considerably between two samples of each of the metals Ti and Zr. This must arise principally from a slight degree of preferred orientation, although x-ray pole figures show no strong evidence of this. The electronic components of expansion differ much less and lead to values of the electronic Grüneisen parameter: $\gamma_e \approx 2.0$ for Ti and $\gamma_e \approx 0 \pm 0.2$ Zr. (auth) (UK)

43577 SELF-DIFFUSION OF Ti, Zr, AND Hf IN THEIR HCP PHASES, AND DIFFUSION OF ^{95}Nb IN HCP Zr. Dyment, F. (Consejo Nacional de Investigaciones Cientificas y Tecnicas, Buenos Aires); Libanati, C. M. J. Mater. Sci., 3: 349-59(July 1968).

Preliminary values for the self-diffusion constants of α-(hexagonal cp) Hf and new values for the self-diffusion constants of α-(hcp) Zr are given. A new determination of the latter was considered necessary since existing values disagree widely and the experimental methods employed in their determination are not considered to be sound. Values obtained for the self-diffusion constants of α-Ti are also reviewed. The activation energies obtained are much smaller than those predicted by relationships based on physical properties of the elements and, within the experimental error, have similar values to those corresponding to the β-(body-centred cubic) phases. Frequency factors are too small to satisfy Zener's theory; when interpreted according to a vacancy model they give negative activation entropies, and the relationship $D_0(\alpha)/D_0(\beta)$ is approximately the same for the three elements. It is suggested that the same diffusion mechanism operates in both the α- and β-phases. If two mechanisms operate in the β-phase, the low temperature mechanism is the same as operates in the α-phase. The influence of ^{95}Nb in ^{96}Zr tracer was also examined. (auth) (UK)

43578 RELATIONS BETWEEN CRACK OPENING DISPLACEMENTS AND HOOP STRESS IN ZIRCALOY-2 PRESSURE TUBES CONTAINING AXIAL DEFECTS. Parry, G. W.; Mills, R. G. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). J. Strain Anal., 3: 159-62(July 1968).

Analysis of the end-of-slit opening measurements in Zircaloy-2 pressure tubes containing axial through-the-wall defects as a function of hoop stress showed that the experimental data do not conform to yielding behavior as predicted for cracked flat plates. It is shown, however, that the results agree closely within certain limits of crack opening displacement with flat-plate behavior if they are corrected by a non-dimensional geometrical correction as given by the equation $\delta = 8\sigma_y a/\pi E(\ln \sec \beta)\ (1 + 1.6a^2/Rt)$. Deviation from the equation occurs at values of δ exceeding about 0.010 in. and is possibly due to gross-bulging effects. (auth) (UK)

43579 FRICTION WELDING: WELDABILITY OF MATERIALS. Weld. Eng., 52: No. 10, 65(Oct. 1967).

The weldability of the following materials by the friction welding process is rated according to good weld, no weld, or brittle weld: Al, Al alloys, brass, bronze, CdO, cast iron, Co, Cu, Cu–Ni, Invar, dispersion hardened Pb, Mg, Mg alloys, Mo, Monel, Ni, Nimonic, Nb, Ag, Ag alloys, steel (plain carbon, alloy, maraging, stainless), Ta, Th, Ti, W, cemented WC, U, V and Zr alloys. (auth)

43580 ABRASIVE WEAR RESISTANCE OF HIGH-CARBON CHROMIUM–MOLYBDENUM BUILT-UP METAL. Levin, V. V. L.; Tereshchenko, A. F. Avtomat. Svarka, No. 7, 30-3(July 1967). (In Russian).

The effect of the C, Cr, Mo, Si and Ti content on the wear resistance of Cr–Mo irons in abrasive wear conditions was studied in order to select an optimal chemical composition of iron for hard-facing the edges of dredge buckets. Thirty-six variants of compositions were tested. In each series of beads, built-up on G13L steel plates in three layers with a total height of 8 to 12 mm, only the content of the alloying elements was changed. Welding was performed under the following conditions: 270 to 290 amp, 22 to 23 V, dc, reverse polarity. Specimens were abrasion tested under a specific load of 0.1 kg/mm². Annealed 45 carbon steel was used as a standard material. Wear resistance was evaluated by the relationship of the weight loss in the built-up specimen to the standard specimen. Hardness measurements and microstructural analyses were made. The built-up Cr–Mo irons have highest wear resistance at 14 to 16% Cr and 1.2 to 1.3% Mo content. Silicon has no noticeable effect on abrasive wear resistance; Ti, within 0.1 to 0.2 and 0.8 to 2% limits, improves wear resistance slightly. Maximum wear resistance is attained at the following composition: 3 to 3.5% C, 14 to 16% Cr, 1.2 to 1.3% Mo, 0.8 to 1.0% Si, and 0.2 to 0.3% Ti. (Rev. Metal Lit.)

43581 FATIGUE OF A MAGNESIUM–ZIRCONIUM ALLOY AT HIGH TEMPERATURE. Skelton, R. P. (Central Electricity Generating Board, Berkeley, Eng.). Metal Sci. J., 2: 144-8 (Aug. 1968).

Fatigue lives of a Mg–0.6 wt % Zr alloy at 430°C and an alternating stress of 1400 psi are presented. Homogenizing and/or precipitation heat treatments carried out on hot-worked material are shown to be generally deleterious to fatigue endurances. The effects of heat treatments are assessed in terms of observed microstructure. It was revealed that high fatigue strengths are incompatible with high creep strengths in certain circumstances. The likelihood of solute diffusion being enhanced by fatigue and the growth of grain-boundary denuded zones are discussed. (auth) (UK)

43582 RECIPROCAL DIFFUSION OF TANTALUM AND TUNGSTEN. Tregubov, I. A.; Kuzina, L. N.; Ivanov, O. S. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR, 180: 423-4(May 11, 1968). (In Russian).

An x-ray analysis was made of the variations in tantalum concentration in the diffusion layer of the W–Ta system and the mutual diffusion of tungsten and tantalum at 2000°C was determined. The curve of the diffusion coefficient as a function of the Ta concentration in the W–Ta system indicates dependence of the mutual diffusion coefficient on the concentration. The diffusion coefficient curve was a sloping minimum at tungsten concentration of 40 to 60 wt % W. (R.V.J.)

43583 DEPOSITION OF HYDROGEN BEAMS ON TUNGSTEN. Klein, Ralph (National Bureau of Standards, Washington, D. C.). Surface Sci., 11: 227-41(July 1968).

The deposition and chemisorption of hydrogen on tungsten have been investigated with a molecular beam apparatus to which a field emission microscope (FEM) is attached. The FEM is operated under liquid helium. The surface temperature of both the surface on which the deposition is made, and the beam, can be varied independently. Advantage is taken of the formation of a sharp boundary line after spreading on a shadowed emitter to evaluate the effect of beam temperature on the condensation process. There is a very marked effect which suggests that the deposition depends on a critical velocity for the hydrogen molecule in the beam. This effect is found only for the second layer where the adsorption forces are relatively weak. The course of the deposition in the first layer can be followed from the characteristics of the electron emission from the tip as coverage proceeds. (auth)

43584 DESORPTION BY ELECTRON IMPACT: OXYGEN ADSORBED ON TUNGSTEN. Madey, Theodore E.; Yates, John T. Jr. (National Bureau of Standards, Washington, D. C.). Surface Sci., 11: 327-51(July 1968).

The interaction of oxygen with a polycrystalline tungsten ribbon has been examined using electron stimulated desorption. At least three binding states of adsorbed oxygen have been identified: a physically adsorbed state which forms at 20°K, and two chemisorbed states designated β_1 and β_2. Both the physisorbed state and the β_1-state liberate positive ions when bombarded by 100 eV electrons; no positive ions were observed on electron bombardment of the β_2-state. The results indicate that the physisorbed state and the β_1-state are molecular. There is an enhanced adsorption of oxygen above 500°K which is primarily due to the creation of binding sites by thermal rearrangement of the oxygen covered surface. The maximum in the ion energy distribution is at 6.5 V for β_1-oxygen and at 0.5 V for physisorbed oxygen. The total cross section Q_{β_1} for electronic desorption from the β_1-state is 7×10^{-19} cm^2; the ionic cross section $Q^+_{\beta_1}$ is $\gtrsim 3.4 \times 10^{-20}$ cm^2. The maximum ion yields g^+ (ions/electron) are $g^+ = 1.5 \times 10^{-6}$ for 300°K adsorption, $g^+ = 3.3 \times 10^{-6}$ for adsorption at 730°K, and $g^+ = 5 \times 10^{-5}$ for adsorption at 20°K. (auth)

43585 DEFORMATION OF WC AND Co ALLOYS. French, David N. (Ingersoll-Rand Co., Princeton, N. J.). Int. J. Powder Met., 4: 55-61(July 1968).

A deformation model for WC–Co alloys is presented. The model is: as the stress is increased to about 70,000 psi, the composite behaves completely elastically. At about 70,000 psi, the yield strength of the cobalt matrix is reached, and for all stresses greater than 70,000 psi, the binder phase exhibits plastic flow. The carbide phase, however, continues to behave elastically until a stress of about 210,000 psi. At 210,000 psi, WC shows limited plastic flow. Since not all the WC grains show slip traces, it is concluded that the "yield strength" is strongly anisotropic and only the most favorably oriented grains exhibit flow at the low stress. From 210,000 psi to fracture, some of the WC grains and all of the cobalt exhibit plastic flow. (auth)

43586 FREQUENCY DEPENDENCE OF TUNGSTEN INTERNAL FRICTION AT ELEVATED TEMPERATURES. Shestopal, V. O. Fiz. Metal. Metalloved., 25: 1104-10(June 1968). (In Russian).

A method of induced torsion oscillations with varying oscillation frequency was used to measure the internal friction of tungsten and BA-3 type tungsten at 1400 to 2500°K and 0.01 to 0.215 Hz frequencies. (tr-auth)

43587 ROLE OF GRAIN-BOUNDARY SLIDING IN HIGH-TEMPERATURE CREEP. Gibbs, G. B. (Berkeley Nuclear Labs., Eng.). Mater. Sci. Eng., 2: 269-72(Jan. 1968).

According to reviewed evidence, grain-boundary sliding is always easier than grain deformation in high-temperature creep of polycrystalline aggregates. Vacancy diffusion and dislocation deformation of grains are both considered. If an imposed strain rate is sufficiently small it will be accommodated by vacancy diffusion in preference to dislocation movement. At high stresses or strain rates, the converse is true. At high rates of strain, when grain deformation is predominantly by dislocation movement, the resistance to sliding is again much less than the grain resistance to shape change. If vacancy diffusion around protuberances in a boundary is not sufficiently rapid to accommodate sliding, plastic deformation of the neighboring grains will occur. The intrinsic ease of grain-boundary sliding under high-temperature creep conditions is established and its role in deforming a specimen is demonstrated. Coherency conditions require that grain-boundary sliding be accompanied by other grain deformation processes, in the absence of large-scale boundary migration. These other processes generally determine the rate laws for creep. The diffusion creep law for a polycrystalline aggregate has the same form as the law for a single grain, differing from it only by a numerical factor. If the restriction on migration is relaxed, coherent deformation can arise from boundary sliding plus migration to relieve stress concentrations. (BBB)

43588 HARD FACING WITH Co ALLOYS. Knotek, O. Ind.-Anz., 89: 1712-13(Sept. 29, 1967). (In German).

Cobalt-base hard-facing alloys are applied mainly to reinforce the surfaces of valves, tool edges, and are applied by gas and Tig welding methods or plasma welding or spraying. The principal alloys contain 1 to 2.7% C, 19 to 32% Cr, 1 to 19% W and may also contain 5% Mo, 28% Ni, 4 or 30% Fe and 2 or 3% B. Partial replacement of Co by Ni and additions of B lead to the formation of an eutectic Ni – B phase producing flow of the alloy at 1100°C, instead of 1300°C. Generally, the alloys contain, in a ductile Co base, mixed carbides of the alloying elements. The compositions are not hardenable by heat treatment but can be precipitation-hardened by extended annealing at 700°C, to some extent. They can be worked by grinding. A phase diagram of the Co – Cr – W – C system at 1050°C and 1% C is presented. (tr-auth)

43589 A STUDY ON RUPTURE PROPERTIES OF LARGE WELDED SPECIMENS OF HT 70 STEEL FOR NUCLEAR PRESSURE VESSELS. REPORT 3. INFLUENCE OF HEAT TREATMENT ON CREEP RUPTURE STRENGTH. Inagaki, Michio; Okane, Isao (National Research Inst. for Metals, Japan). Yosetsu Gakkaishi, 37: 621-6(June 1968). (In Japanese).

The influence of heat treatment after welding on large size welded specimens of Type HT70 steel for nuclear pressure vessels was investigated. The creep rupture strength of welded specimens, treated at 650 and 900°C, for 2.5 hr, with furnace cooling, was superior to that of as-welded specimens, but heat treatment at 550°C for 2.5 hr, with furnace cooling decreased creep rupture strength. (P.G.C.)

Structure and Phase Studies

Refer also to abstracts 43151 and 44216.

43590 (ANL–7299, pp 201-19) METALLURGY OF THE ACTINIDE METALS. (Argonne National Lab., Ill.).

Investigations concerned with crystal structure, transformations, and radioinduced growth of U are reported along with data on compounds of ternary U – Al – group-VIII transition elements. Information is included on preparation of high-purity Pu, and crystal structure and deformation of alpha-phase Pu. Research on electronic structure and Moessbauer effect in Np is summarized. Results of investigations of pressure effects on transformations of actinide metals are also included. (J.R.D.)

43591 (ANL–7299, pp 227-37) DEFORMATION AND PLASTICITY. (Argonne National Lab., Ill.).

Summaries of investigation results are presented on fatigue of monocrystals and polycrystals, flow stress and work hardening, effects of twinning on cph polycrystals, habit planes in ZrH, and embrittlement of Nb and V. (J.R.D.)

43592 (ANL–7299, pp 238-45) TRANSFORMATIONS. (Argonne National Lab., Ill.).

Results of investigations are presented concerning dislocations in hcp → bcc diffusionless transformations of metals, and effects of magnetic transitions on elastic properties of metals such as Gd, Dy, and Er. (J.R.D.)

43593 (ANL–7299, pp 246-50) DIFFUSION IN METALS. (Argonne National Lab., Ill.).

Results of investigations of diffusional processes in metals and alloys using isotopes are reported. The isotope effect was measured to determine diffusion of Zn in Ag, Cu, CuZn, and Zn. Other measurements of ^{65}Zn, ^{72}Ga, and ^{60}Co in Al. (J.R.D.)

43594 (ANL–7299, pp 251-64) TRANSITION METALS AND ALLOYS. (Argonne National Lab., Ill.).

Investigations of these metals and alloys were directed toward their magnetic properties, structures and occurrences of intermediate phases, thermodynamic properties, and nuclear magnetic resonance. (J.R.D.)

43595 (ANL–7299, pp 265-7) THEORETICAL STUDIES OF DILUTE ALLOYS. (Argonne National Lab., Ill.).

Investigations of uncertainties associated with Knight shift in dilute silver alloys are reported. Data are presented on Knight shift coefficients for monovalent fcc metals as function of the Fermi wave number incorporating a lattice vector. Calculated values are also included on the average Knight shift per at. % of solute in Ag alloys. (J.R.D.)

43596 (ANL–7299, pp 280-9) X-RAY AND NEUTRON DIFFRACTION STUDIES. (Argonne National Lab., Ill.).

Research progress on diffraction equipment design is reported along with a description of neutron instrument development for AARR. Results of investigations are also reported on crystallographic computer programs, neutron scattering amplitudes of ^{61}Ni and ^{64}Ni, structure of manganese silicides, crystal structure of $UO_2(NO_3)_2 \cdot 2H_2O$, crystal structure of selenious acid, crystal structure of $Th(NO_3)_4 \cdot 5H_2O$, crystal structure of $K_4Fe(CN_6 \cdot 3D_2O$, and atomic arrangements in liquid alloys. (J.R.D.)

43597 (CEA-R–3448) DILATOMETRIC, RADIOCRYSTALLOGRAPHIC, AND MICROSTRUCTURAL STUDY OF TRANSFORMATIONS PRODUCED BY QUENCHING AT DIFFERENT RATES WITH SUBSEQUENT TEMPERING, IN ZIRCONIUM–COP-

PER ALLOYS CONTAINING LESS THAN 5 PERCENT COPPER BY WEIGHT. Couterne, Annick (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar. 1968. 132p. (In French). Dep.

Thesis.

When β-phase zirconium-copper alloys are temper hardened, structural transformations occur leading to metastable phases which are not predicted by the equilibrium diagram. The formation mechanism is always of the martensitic type but the crystalline structures are different according to the amount of the added element; i.e., when the copper content is about 1 per cent by weight, a hexagonal α' phase is obtained having parameters which are very close to those of the α solid solution; its structure is strongly acicular. When the copper content is equal or greater than 1.6 per cent Cu by weight, a new ω phase has been shown to exist; this phase has a hexagonal symmetry ($c/a = 0.624$) and the crystals formed are of sub-microscopic size. The ω phase is decomposed on isothermal or anisothermal tempering, probably by shearing, at a temperature which is in practice below 550°C; an α supersaturated solid solution is first formed and gradually changes to the α equilibrium solid solution with progressive precipitation of the compound Zr_2Cu. (auth)

43598 (IS-T-240) GADOLINIUM-LEAD PHASE SYSTEM. Demel, John Tallev (Ames Lab., Iowa). May 1968. Contract W-7405-eng-82. 35p. Dep. CFSTI.

Thesis.

The gadolinium-lead binary phase diagram has been determined by differential thermal analysis, metallographic and x-ray methods. The addition of lead to gadolinium lowers the α-β transformation from 1258 to 1212°C by an inverse peritectic transformation. Gadolinium additions to lead raise its melting temperature by a peritectic transformation from 327 to 328°C. The room temperature solid solubility is negligible for the pure materials. A eutectic transformation occurs at 14.5 at. % Pb and 1120°C. There are six intermetallic compounds; Gd_5Pb_3 melts congruently at 1670°C while Gd_5Pb_4, $Gd_{11}Pb_{10}$, Gd_6Pb_7, $GdPb_2$, and $GdPb_3$ melt peritectically at 1460, 1225, 1160, 1010 and 969°C, respectively. In addition there is a polymorphic transformation in Gd_5Pb_4 at 1410°C. The crystal structures of Gd_5Pb_3, Gd_5Pb_4 and $GdPb_3$ are discussed. (auth)

43599 (NYO-3001-2) A STUDY OF THE INTERACTION BETWEEN POINT DEFECTS AND DISLOCATIONS THROUGH DISLOCATION DAMPING EXPERIMENTS. Final Report. [Bauer, Charles L.] (Carnegie-Mellon Univ., Pittsburgh, Pa. Metals Research Lab.). June 1, 1968. Contract AT(30-1)-3001. 7p. Dep. CFSTI.

A review of work conducted from 1962 to 1968 on dislocation damping measurements of segregation of Ge solute atoms in Ge–Cu alloys, structure sensitivity of Type II semiconductors, internal friction, Young's modulus, and superconductivity of Nb, thermal depinning of dislocations from solute atom pinning points, and relation of strain amplitude dependence of internal friction to the magnetic state of Nb monocrystals. Sections reviewed were previously published as doctoral theses or journal articles. Nineteen references. (P.G.C.)

43600 (TID-24562) THE INTERACTION BETWEEN POINT DEFECTS AND DISLOCATIONS THROUGH DISLOCATION DAMPING EXPERIMENTS. Final Report. (Carnegie-Mellon Univ., Pittsburgh, Pa. Metals Research Lab.). June 1, 1968. Contract AT(30-1)-3001. 7p. Dep. CFSTI.

SOLIDS—dislocation interactions with point defects in, studies
COPPER ALLOYS & SYSTEMS—dislocation interactions with solute atoms in dilute, studies
SUPERCONDUCTORS—dislocation interactions in Type II, studies
NIOBIUM—superconductivity of, dislocation interaction studies
INTERNAL FRICTION—measurements in alloys and superconductors (D.L.C.)

43601 INFLUENCE OF PLASTIC DEFORMATION ON THE F.C.C. ⇌ D.H.C.P. TRANSFORMATION IN CERIUM. Koch, C. C.; McHargue, C. J. (Oak Ridge National Lab., Tenn.). Acta Met., 16: 1105-15(Sept. 1968). (ORNL-P-3367).

Quantitative metallography was used to examine the influence of plastic deformation on the fcc ⇌ dhcp martensitic transformation in cerium. Some aspects of the athermal transformation were also studied. The M_s temperature for fcc → dhcp decreased with decreasing grain size. The morphology of the athermally formed dhcp is that of clusters of planar sheets. The growth of the dhcp phase occurs by the increasing density of occurrence of the individual sheets. There is a small isothermal component to the reversion of the athermally formed dhcp reflected by metallographic evidence of incoherent boundary migration. Plastic deformation induced transformation from fcc to dhcp from the lowest temperature studied (−77°C) up to M_d temperature (~225°C). The M_d temperature is above both the A_s and A_f temperatures (100°C and 150°C, respectively). The fcc regions untransformed by plastic deformation were stabilized to subsequent athermal transformation. The dhcp martensite formed by deformation was very stable to reversion, not reverting until consumed by recrystallized fcc grains. (auth)

43602 ADDITIONAL OBSERVATIONS ON GRAIN REFINING IN URANIUM ALLOY CASTINGS. INFLUENCE OF LOW ADDITIONS. Colombie, M. (CERCA, Romans-sur-Isere, France); Decours, J.; Foure, M.; Magnier, P. Mem. Sci. Rev. Met., 65: 401-13(May 1968). (In French).

The kinetics involved in rapid solidification of U-base—Mo alloys containing small additions, in the range of 100×10^{-6} to 1100×10^{-6} parts, of B, Be, C, or P are discussed. The influence of these elements of low atomic numbers on crystallization of the α and γ phases of the alloys and on grain refinement and homogenization of structure is described. (P.G.C.)

43603 INFLUENCE OF A UNIAXIAL COMPRESSIVE STRESS ON THE KINETICS OF THE $\beta \rightarrow \alpha$ TRANSFORMATION IN URANIUM–CHROMIUM ALLOYS AND ON THEIR α PHASE CRYSTALLISATION CONDITION. Violle, M. (Faculte des Sciences, Nancy CEA, Gif-sur-Yvette, France). Mem. Sci. Rev. Met., 65: 415-24 (May 1968). (In French).

Micrographic examination shows a decrease in incubation time and an increase in transformation rate. The α grain is refined when the stress is applied in the temperature range where nucleation is weak. (auth)

43604 INFLUENCE OF SPARK DISCHARGES ON THE TRUE STRUCTURE OF TUNGSTEN CRYSTALS. Dudko, G. V.; Mitrofanov, O. V.; Ovechkin, O. A. Elektron. Obrab. Mater., No. 2, 3-7(1967). (In Russian).

After electric-spark treatment a defective surface layer 0.05 mm thick forms on the surface of W crystals; in the spark-affected layer an originally single crystal becomes converted into polycrystalline form. The spark-affected layer is in a "cold-worked" state, with a highly-distorted lattice, numerous fine cracks, and foreign inclusions coming from the sparking electrode. On annealing W single crystals previously subjected to electric sparks, the surface layer recrystallizes, forming a textured microstructure. (auth)

43605 FORGING EMBRITTLEMENT OF Zr–2.5 PERCENT Cu. Armand, M.; Demars, H.; Givord, J.-P.; Herold, R. Mem. Sci. Rev. Met., 65: 435-43(May 1968). (In French).

The forging brittleness of Zr-2.5% Cu alloys is due to an excessively long β phase preheating time. To eliminate the brittleness, it is sufficient to allow the ingot to cool prior to a second preheating. (auth)

43606 MAGNETISM AND CRYSTAL STRUCTURE. Balasundaram, L. J. (National Metallurgical Lab., Jamshedpur, India). Trans. Indian Inst. Metals, 20: 191-5(Dec. 1967).

Some complex crystal structures occurring in binary metallurgical equilibrium diagrams have been examined from the point of view of magnetic interactions of component elements and it is suggested that complex structures like σ, α-manganese occur when ferromagnetic alignment between closest neighbors changes over to antiferromagnetic alignment or vice-versa. These structures may be considered to be magnetically ordered compounds, with each structure corresponding to different degrees of magnetic order. These structures have been represented on a magnetic diagram showing relationship between spin orientation and crystal structure. The diagram has been used to account for the presence or absence of sigma phase in binary alloy systems of transition metals. (auth)

43607 NUCLEATION AND GROWTH OF SILVER FILMS DEPOSITED ON MICA SUBSTRATES IN ULTRA-HIGH VACUUM. Jaeger, H.; Mercer, P. D.; Sherwood, R. G. (Univ. of Melbourne). Surface Sci., 11: 265-82(July 1968).

The nucleation and growth of silver films deposited in ultrahigh vacuum over a wide range of substrate temperatures and deposition rates were studied using electron microscopy. As found previously, epitaxy occurred only if the mica was cleaved in vacuum and the temperature was in the region of 0 or 300°C. The nuclei were nearly randomly oriented and their structure and concentration ($6-7 \times 10^{11}$ cm^{-2}) were virtually independent of the deposition conditions. Thus epitaxy was independent of nucleation and was determined only during the growth stages. During growth at ~300°C, coalescence was liquid-like throughout and misorientations between coalescing particles were removed continuously. At ~0°C, however, liquid-like coalescence ceased when particles exceeded ~300 Å in diameter and polycrystalline networks were formed which suddenly recrystallized into epitaxed sheets provided the rate of deposition was >50

Å/min. These different modes of growth produced films with different defect distributions. (auth)

43608 INNER SOURCES IN LOW ENERGY ELECTRON DIFFRACTION: TUNGSTEN (110). Baudoing, R.; Stern, R. M.; Taub, H. (Polytechnic Inst. of Brooklyn). Surface Sci., 11: 255-64(July 1968).

Low energy electron diffraction studies of the (110) surface of tungsten show diffuse features which are observed to rotate with the same angular displacement as the crystal. Such features are considered to have coherent sources located in the crystal itself as their origin. These sources have a three-dimensional nature in the case of the observed Kikuchi diagrams, and a monodimensional nature in the case of the observed circles and streaks. A description of the excitation of these sources is proposed, which is based on the existence of a crystalline term in the atomic form factor consisting of lobes in the scattering cross-section oriented in the direction of neighboring atoms in the bcc structure. (auth)

43609 INVESTIGATION INTO THE ORDERED STRUCTURES OF Zr_6O AND Zr_3O SUBOXIDES. Kovba, L. M.; Kenina, E. M.; Kornilov, I. I.; Glazova, V. V. (Inst. of Metallurgy, Moscow. Moscow State Univ.). Dokl. Akad. Nauk SSSR, 180: 360-3(May 11, 1968). (In Russian).

Ordering of solid solutions of oxygen in α zirconium was studied with specimens of Zr_6O and Zr_3O. The specimens were prepared in an arc furnace in pure argon atmosphere. Prepared alloys with the oxygen content of 0, 8, 12, 14, 14.5, 15, 16, 17, 18, 20, and 25 at. % were treated at 600°C for 1032 hr, 800° for 400 hr, and at 1000° for 200 hr, followed by annealing in ice water. Data obtained confirmed the presence of ordered structure in the Zr_3O suboxide. The absence of superstructure lines on the x-ray picture of Zr_3O reveal abnormal changes in parameters and volume of elementary cells which are the results of the ordering. After annealing the Zr_6O alloys did not exhibit any minimum in the diagrams of the parameter, elementary cell volume-composition which also confirmed the instability of Zr_6O at given temperature. It was suggested that ordering of Zr_6O suboxides should be studied by a more sensitive method than x-ray or neutronographical methods. (R.V.J.)

43610 CONTINUOUS AND DISCONTINUOUS PRECIPITATION REACTIONS IN U–Mo (1.5 PERCENT) ALLOYS. Giraud-Heraud, Francois; Guillaumin, Jean; Sifferlen, Raymond (Laboratoires de Veurey, Isere, France). Compt. Rend., Ser. C, 267: 40-2(July 1, 1968). (In French).

Generalized decomposition of the gamma phase in U–Mo (1.5%) alloys that are cooled rapidly is preceded by heterogeneous growth of lamellar structures. The morphologic and crystallographic characteristics of this transformation are those of discontinuous precipitation reactions. (tr-auth)

43611 THE GRAIN FINING EFFECT OF ZIRCONIUM IN Mg–Zr ALLOYS. Sauerwald, F. (Univ., Halle-Wittenberg, Ger.). Naturwissenschaften, 55: 227(May 1968). (In German).

Experimental studies on small rods of Mg–Zr alloy confirmed that the site of the crystal nucleus is originally central but that this site is moved to the grain boundaries by a later grain boundary migration. (J.S.R.)

43612 LATTICE PARAMETER STUDY OF TITANIUM–MOLYBDENUM AND NIOBIUM–MOLYBDENUM ALLOYS. Upadhyaya, G. S. (Univ. of Roorkee, India). Trans. Indian Inst. Metals, 20: 53-4(Mar. 1967).

Information from a study of electronic structure of the alloys of early transition metals is presented. The applicability of lattice parameter measurement of titanium–molybdenum and niobium–molybdenum binary alloys is discussed. The results confirm a change in properties at about 5.6 electrons/atom and suggest a split in the d-sub-bands at this critical composition. (auth)

Radiation Effects

Refer also to abstracts 44259 and 44269.

43613 (ANL–7299, pp 144-9) EXPERIMENTAL IRRADIATIONS OF FUELS AND STRUCTURAL MATERIALS. (Argonne National Lab., Ill.).

Results of irradiation tests of encapsulated US pellets and UO_2–Na pastes are presented. Activities in a program to measure effects of radioinduced hydrogen in pressure vessel steel are described. (J.R.D.)

43614 (ANL–7299, pp 290-308) IRRADIATION EFFECTS AND DEFECTS IN METALS. (Argonne National Lab., Ill.).

Results of investigations on migration and coalescence of gas bubbles in solids, defect clusters in irradiated Cu and Au, thin-film irradiation at low-temperatures, recovery of irradiated Cu, energy release by irradiated Cu, defects in fcc metals, lattice dynamics of fcc crystals, radioinduced precipitation in Al–Zn alloys, and hardening of Cu. (J.R.D.)

43615 (BNWL–710) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Quarterly Progress Report, November–December 1967 and January 1968. Claudson, T. T. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 1968. Contract AT(45-1)-1830. 257p. Dep. CFSTI.

Research performed by several participating agencies is summarized. Information and data are presented on radiation effects on stainless steel, radiation effects on iron single crystals, effects of hydrogen charging on Hy-80 steel, radiation effects on A302 B steel, annealing SM-1A pressure vessel, radiation effects on Hastelloy alloys, and radiation effects on A 212-B steel. Supporting studies for fast reactors are summarized along with those for ATR gas loop. Investigations of superalloy corrosion are also reported along with tensile tests on SA 533-B steel. (J.R.D.)

43616 (CEA-R-3280) INTERACTIONS ENTRE LES IMPURETES ET LES DEFAUTS CREES PAR IRRADIATION DANS LE FER. (Interactions Between Impurities and Defects Created by Irradiation in Iron). Vigier, Pierre (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Jan. 1968. 105p. (In French). Dep.

Research completed from 1942 to 1966 on interactions between impurities and defects in irradiation of high-purity Fe at low temperatures is reviewed. Aspects discussed include types of point defects including migration, energy of formation, isolated interstitials, and network interstitials. Effects of minor additions of other metals (0.0005 to 1.5 ppM) Al, Be, Co, Ni, Pt, Sb, Si, Ga, Th, are reported. The value of magnetic after-effects in the investigation of point defects is stressed. Equipment and experimental processes are described. (P.G.C.)

43617 (DP-MS–67-20) EFFECTS OF IRRADIATION ON PROPERTIES OF COBALT. Angerman, C. L. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). June 2, 1967. Contract AT(07-2)-1. 10p. (CONF-670602–30). Dep. CFSTI.

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif.

The effects of neutrons on the hardness, density, dimensions, and microstructure of Co are reported. (P.G.C.)

43618 (IN–1200) EFFECTS OF IRRADIATION ON THE SURFACE ACTIVITY AND DIFFUSIVITY OF HYDROGEN IN STEELS. Brinkman, C. R.; Beeston, J. M. (Idaho Nuclear Corp., Idaho Falls). June 1968. Contract AT(10-1)-1230. 14p. Dep. CFSTI.

As a prerequisite to determining the combined effects of irradiation and hydrogen content upon the mechanical properties of ASTM A542, A302B, and HY 80 pressure vessel steels, the cathodically induced hydrogen occlusion was studied. The rate of occlusion increased with increasing current density, poison concentration (sodium arsenate or carbon disulfide), and irradiation. The induction period was reduced by increased current density and irradiation. Specimens were irradiated to 4×10^{17} n/cm^2 ($E > 1$ MeV) and the radioactivity measured 2 to 3 r/hr at contact prior to testing. Increasing the poison concentration and irradiation also resulted in an increase in the apparent "supersaturation" solubility. The increased occlusion rates found with the irradiated specimens were attributed to either changes in the specific rate constants for absorption and desorption or the number of surface active sites. The increased apparent solubility limit was attributed to increased hydrogen trapping. (auth)

43619 (JPRS–46209) EFFECT OF RADIOACTIVE IRRADIATION ON THE MECHANICAL PROPERTIES OF SOLIDS. Lenskiy, V. S. Translated from Inzh. Sb., 28: 97-123(1960). 39p. CFSTI.

A survey is presented of the literature on radiation effects (mainly of neutrons) on the physico-mechanical properties of materials. Attention is given to the generalization and systemization of the data for prediction purposes. The mechanism of radiation effects is described briefly, and the effects on elastic, plastic, and creep properties are considered. Finally, some general considerations in calculating the irradiation-induced changes are given. (D.L.C.)

43620 (NRL–6721) NOTCH DUCTILITY PROPERTIES OF SM-1A REACTOR PRESSURE VESSEL FOLLOWING THE INPLACE ANNEALING OPERATION. Potapovs, Uldis; Hawthorne, J. Russell; Serpan, Charles Z. Jr. (Naval Research Lab., Washington, D. C.). May 21, 1968. 30p.

The embrittlement condition of the Army SM-1A reactor pressure vessel, as modified by the recently completed in-place anneal, was assessed and an analysis was made of the reembrittlement behavior of the vessel steel with subsequent radiation service. Experimental results from the reactor surveillance program developed through one complete irradiation and annealing cycle are presented, together with a summary of experimental information on the annealing response of the vessel steel (A350-LF1, Mod.) from accelerated irradiation programs. These data indicate a 0°F maximum pressure vessel wall Charpy-V 30 ft-lb transition temperature after the in-place anneal versus a –80°F preservice transition temperature (based on the notch-ductility properties of a duplicate ring forging). The maximum Charpy-V 30 ft-lb transition temperature of the pressure vessel before the annealing operation was estimated at 190°F. A projection of postanneal pressure vessel lifetime in terms of neutron fluence >0.5 MeV was derived from spectra calculations and the experimentally predicted reirradiation response of the pressure vessel steel. The maximum permissible vessel wall fluence is estimated at 5.5×10^{19} n/cm^2 >0.5 MeV. This is comparable to 124.7 Megawatt years of reactor operation. (auth)

43621 (RCN–96) DIRECT OBSERVATION OF DAMAGE IN NEUTRON IRRADIATED VANADIUM. Elen, J. D. (Reactor Centrum Nederland, Petten). Dec. 1967. 52p. Dep.

Irradiation of commercial V at ca 80°C to a fast neutron dose of 7.4×10^{19} n/cm^2, results in a high density of arrays of presumably interstitial clusters of about 70Å. There is evidence of a denser homogeneous distribution of separated small dots near the resolution of the microscope. These are probably depleted zones. 0.1 Micron wide denuded zones along grain boundaries are explained in terms of interstitial migration. After annealing at 400 to 600°C, large $\{111\}$ $\frac{1}{2}$ a $\langle 111 \rangle$ vacancy loops are formed, which anneal out at 700°C within one hour. (auth)

43622 (WAPD-TM–746) RADIATION-ENHANCED RELAXATION IN ZIRCALOY-4 AND IN A ZIRCONIUM + 2.5 WT. PERCENT NIOBIUM + 0.5 WT. PERCENT COPPER ALLOY (LWBR DEVELOPMENT PROGRAM). Kreyns, P. H.; Burkart, M. W. (Bettis Atomic Power Lab., Pittsburgh, Pa.). May 1968. Contract AT(11-1)-Gen-14. 27p. Dep. CFSTI.

An irradiation-enhanced strain relaxation has been observed in Zircaloy-4 and in a zirconium + 2.5 wt % niobium + 0.5 wt % copper alloy for fast-neutron fluxes of 2.4×10^{14} nv > 1 MeV. The effects of several material and test parameters were investigated, and the results compared with out-of-pile stress relaxation data using a thermally-activated creep model. It was found that in-reactor relaxation of Zircaloy-4 was temperature and structure sensitive, independent of initial stress, and consistent with an accelerated thermal creep model. (auth)

43623 RELATIONSHIP BETWEEN PEAK ANNEALING TEMPERATURE AND FAST INTEGRATED DOSE FOR IRRADIATED COPPER, COPPER–ALUMINUM, AND COPPER–SILICON ALLOYS. El-Shanshury, I.; Mohamed, H. At. Energ. (USSR), 25: 30-5(July 1968). (In Russian).

The effect of aluminum and silicon additions in copper and the effect of fast-neutron integrated doses on the Brinell hardness of copper and its alloys were investigated. Curves of isochronal annealed samples irradiated by different neutron beams and the effect of alloying elements on the peak temperature of annealing were studied. The different alloying element atoms caused the difference in hardness of non-irradiated samples, but did not affect the hardness of the samples during irradiation. This reveals that no other effects can be attributed to solute atom valency A correlation between the peak temperature of annealing and the ratio of the activation energy of vacancy migration and self diffusion was studied. Both parameters changed with increase in solute atom concentration and the effect was attributed to the distortion produced in the lattice structure of copper due to the presence of aluminum and silicon. The direct dependence of the peak temperature on the cube root of the fast integrated dose was observed for doses ranging from 10^{18} to 10^{20} n/cm^2. This strongly emphasizes the sensitivity of this parameter to the changes produced in the structure during irradiation and at its subsequent annealing. The increase in peak temperature with the increase in $(nvt)^{1/3}$ implies that the number of obstacles (zones) produced during irradiation increases continuously and does not saturate at doses up to 10^{20} n/sm^2. These results explain the deviation from direct dependence for hardness or yield strength values at high integrated doses to be due to the decrease in the effective size of the zones by the mechanism of the capture of dynamic crowdion coming from a newly formed zone of one of already existing zones. (auth)

43624 INFLUENCE OF SOME ADDITION ELEMENTS ON THE RECOVERY OF ALUMINIUM EXPOSED TO NEUTRON RADIATION AT 78^{0}K. Dimitrov-Frois, C.; Dimitrov, O. (CNRS, Vitry-sur-Seine, France). Mem. Sci. Rev. Met., 65: 425-33(May 1968). (In French).

Specimens of twice-refined, zone-melted Al with small additions, 0.0100 to 0.0200 at.% of Ag, Cu, or Mg, were irradiated at 78°K in a fast neutron flux at 3.5 and 5.5×10^{17} n/cm^2. Irradiation induced defects were eliminated by heat treatment. Kinetics of recovery at different stages are interpreted and the influence of types of metal additions are discussed. (P.G.C.)

43625 EFFECT OF OXYGEN ON "STAGE III" ANNEALING IN NEUTRON-IRRADIATED NIOBIUM. Williams, J. M.; Brundage, W. E.; Stanley, J. T. (Oak Ridge National Lab., Tenn.). Metal Sci. J., 2: 100–4(May 1968). (ORNL-P-3394).

The effect of O_2 on "Stage III" annealing in neutron-irradiated Nb was investigated by means of internal friction and electrical resistivity techniques. The O_2 Snoek peak decreased during isothermal annealing at 150°C, and the kinetics of this process were similar to that of the electrical resistivity decrease at the same temperature. Oxygen-free samples exhibited no annealing effects in Stage III. It was concluded that Stage III is caused by the migration of O_2 to radiation produced defects. (auth) (UK)

43626 RECOVERY OF FAST NEUTRON IRRADIATED MOLYBDENUM AT LOW-TEMPERATURE. Takamura, Saburo; Maeta, Hiroshi; Okuda, Shigeo (Japan Atomic Energy Research Inst., Ibaraki). J. Phys. Soc. Jap., 25: 418-20(Aug. 1968).

The isochronal annealing studies of electrical resistivity of Mo after fast neutron irradiation at liquid helium temperature were performed. Recovery spectra of annealed and cold worked specimens were compared. An apparent change in stage I due to cold work was found. (auth)

Ceramics and Cermets

Refer also to abstracts 42886, 43519, and 43521.

43627 (ANL–7299, pp 14-113) FAST-REACTOR FUEL-ELEMENT DEVELOPMENT AND FABRICATION. (Argonne National Lab., Ill.).

Research and development progress is reported on metal fuel development, oxide fuel development, carbide fuel development, development of Doppler-Element loading techniques, fast-reactor jacket development, zero-power fuels and fuel elements, and EBR-II assistance. (J.R.D.)

43628 (ANL–7299, pp 268-79) PHYSICAL CERAMICS RESEARCH. (Argonne National Lab., Ill.).

Research progress is reported on transport processes in ionic oxides, grain-boundary energies of oxides, defects in nonstoichiometric oxides, defects in hypostoichiometric molybdenum oxides, oxygen diffusion, and interface migration in alkali halides. (J.R.D.)

43629 (LA–3933) ADVANCED PLUTONIUM FUELS PROGRAM. Quarterly Status Report, January 1–March 31, 1968. (Los Alamos Scientific Lab., N. Mex.). Apr. 1968. Contract W-7405-eng-36. 61p. Dep. CFSTI

Research and development progress is summarized on sodium technology, ceramic Pu fuel materials, and compatibility of Na-bonded Pu–U alloys and Pu–U nitrides with cladding materials. Research on reactor physics is also reported along with results of fast reactor fuel examination, and results of investigations devoted to advanced systems. (J.R.D.)

Corrosion and Erosion

43630 DEPOSITION OF PYROLYTIC CARBON IN THE PORES OF GRAPHITE BODIES. I. INTRODUCTION TO AND RESULTS OF DEPOSITION EXPERIMENTS USING METHANE. Vohler, O.; Reiser, P. L.; Sperk, E. (Sigri Elektrographit GmbH, Meitingen, Ger.). Carbon, 6: 397-403(June 1968).

The necessity for the deposition of a pyrolytic carbon layer within the pore system of moderator graphite for efficient oxidation protection is discussed. Experiments were performed in which such deposits were obtained by the pyrolysis of methane. The influence of temperature, pressure, and gas velocity was studied. (UK)

Preparation and Fabrication

Refer also to abstracts 43551, 43558, and 44856.

43631 (ANL–7299, pp 120-37) DEVELOPMENT OF CERAMIC FUELS. (Argonne National Lab., Ill.).

Research and development are reported on thermal stability of Pu ceramics, U–mixed anion systems, electric properties and electronic configurations of actinide metal compounds with nonmetals of groups IV to VI, thermal conductivity and heat capacity of actinide compounds, Th–U–Pu phosphides, and mechanical properties of U compounds. (J.R.D.)

43632 (LA-3960) JOINING GRAPHITE TO GRAPHITE WITH TRANSITION METAL FOILS. Sandstrom, Donald J. (Los Alamos Scientific Lab., N. Mex.). June 1968. Contract W-7405-eng-36. 85p. Dep. CFSTI.

Results of experiments to bond Fe, Mo, Ta, W, and Zr to a dimensionally stable high-coking graphite bonded with polymerized furfuryl alcohol resin are reported. It is concluded that the strongest solid-carbide joints will be produced with Zr and that fully diffused joints are superior to solid-carbide joints at elevated temperatures. The strength of joints produced with Fe were low. (P.G.C.)

43633 (TT-67-58017/3-4, pp 21-7) SOME PHYSICAL PROPERTIES OF NUCLEAR GRAPHITE. Marinkovic, V.; Kolar, D.; Krasevec, V.; Trontelj, M.; Urbanc, A.; Vene, N. Translated from Rudarsko Met. Zbornik, No. 3/4, 239-44 (1967).

Density, porosity, permeability, crystal anisotropy, and electric conductivity of 3 types of graphite, prepared at Sibenik were measured and compared with foreign nuclear graphites. (P.G.C.)

43634 (WANL-TME-1446) COMPATIBILITY OF N TYPE LEAD TELLURIDE AND BORON NITRIDE. COMPACT THERMOELECTRIC CONVERTER. Godshall, J. L. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). July 18, 1966. Contract AT(30-1)-3584. 25p. Dep. CFSTI.

A study was made of the time-temperature-pressure parameters in the gas-pressure sintering of 3N PbTe/Grade A BN materials for thermoelectric modules. Compatibility tests were conducted using 30-min compactions at 750°C under 4,000 to 10,000 psi pressures and at 650°C under 6,500 to 15,000 psi pressures. Hardness, penetration, densification, and microstructure were characterized. It is recommended that a compressive stress of 12,500 to 15,000 psi at 650°C be used in the gas pressure sintering operation. (D.L.C.)

43635 METHOD OF MANUFACTURING A HEAT-INSULATING REFRACTORY CONCRETE AND PRODUCT OBTAINED BY THE METHOD. Dubois, Frederic; Mauny, Pierre (to Commissariat a l'Energie Atomique). British Patent 1,117,849. June 26, 1968. Priority date Apr. 27, 1965, France.

Lightweight aggregates, formed by a mixture of substantially spherical expanded clay particles and asbestos powder, are added to a high alumina cement to form a heat-insulating refractory concrete. (P.G.C.)

43636 PLATING BY REACTION OF GASEOUS COMPOUNDS. Blocher, John M. Jr. (Battelle Memorial Inst., Columbus, Ohio). pp 133-41 of Protection Against Corrosion by Metal Finishing.

From International Conference on Protection Against Corrosion by Metal Finishing, Basel, Switzerland. See CONF-661138.

The kinetics involved in the application of protective coatings of metals, intermetallic compounds, metalloids, carbides, borides, and silicides, by chemical vapor deposition, are discussed. (P.G.C.)

43637 PREPARATION OF PURE DENSE HYPOSTOICHIOMETRIC URANIUM CARBIDE. Hanson, Lloyd A. (to United States Atomic Energy Commission). U. S. Patent 3,398,098. Aug. 20, 1968.

A method for preparing hypostoichiometric uranium carbide that includes blending suitable mixture of UO_2, U_3O_8, or UO_3 and carbon powder in an amount sufficient for normally producing hyperstoichiometric or stoichiometric uranium carbide and adding to the blend small amounts of uranium alloys of the order of 1 to 5% by weight is described. The carbothermic reduction process is used for heating the mixture to a temperature of the order of 1700 to 1750°C so that the alloy decomposes, the foreign metal is removed as a vapor and the free uranium combines to produce hypostoichiometric UC. (AEC)

43638 VOLTAGE BALANCE IN THE ANODIC MACHINING OF TUNGSTEN CARBIDE—COBALT ALLOY VK8. Lezin, A. I.; Evseeva, M. A.; Fedyushkina, Ya. A. Elektron. Obrab. Mater., No. 2, 28-31(1967). (In Russian).

The nature of the voltage balance characterizing the electrolytic (anodic) machining of metals is discussed with special reference to the hard WC–Co alloy VK8. The total voltage is made up of components characterizing the anodic process, the cathodic process, and the ohmic potential difference which is to a large extent not usefully employed. The balance relationships are analyzed in order to find the best conditions for the electrochemical treatment of the hard alloy in question; in general low voltages (6 to 8 V) are preferred. (auth)

43639 PROCESS FOR THE PRODUCTION OF CARBIDE PARTICLES. Bildstein, Hubert; Knotik, Karl; Leichter, Peter (to Nukem, Nuklear-Chemie und -Metallurgie Ges mbH). British Patent 1,122,126. July 31, 1968. Priority date Feb. 17, 1966, Austria.

Spherical carbide particles, for nuclear fuels or other purposes, are produced by coating carbide forming metals with carbon black and heating in crucibles to 1500°C or higher. The process may be used to produce carbides of reactor poisons such as boron carbide, europium carbide or gadolinium carbide, from the metals, oxides or other compounds. (P.G.C.)

43640 USING DIAMOND ABRASIVE WHEELS. Hughes, F. H. Grinding Finish., 13: No. 11, 30-3(Nov. 1967).

The proper use of diamond abrasive grinding wheels to remove WC is discussed. Diamond wheel parameters (mesh size, grit size, grinding ratio), wet and dry grinding, and grinding wheel spindle bearings, as they affect grinding of WC are considered. Three uses of diamond abrasive grinding wheels are shown—surface grinding with a D1A1 wheel; grinding of milling cutters, flutes in WC reamers, etc., with D11V9 flaring cup and D6A9 straight cup wheels; and electrolytic grinding, where the diamond wheel is used in the manufacture and reconditioning of WC inserts and WC tipped tools. (auth)

43641 JOINT BETWEEN GRAPHITE BODIES. (to United States Atomic Energy Commission). French Patent 1,414,166. Filed Oct. 21, 1964.

In order to obtain a gas and liquid-tight joint between two graphite bodies (e.g., the envelope and the end-plug of a nuclear reactor fuel element) the bodies are subjected to an initial pressure of 980 Kg/cm^2 at the interface, the temperature of which, then being raised to 2500°C by resistance-heating by means of an ac-impulse (60 Hz, 18.3 V, 8 to 50 milliseconds), the current at the same time exciting an electro-magnet, which acts on the pressure means, increasing the pressure at the interface to 1050 kg/cm^2. (IIB)

43642 NUCLEAR REACTOR FUEL ELEMENT AND METHOD OF MANUFACTURING SAME. (to Atomic Energy of Canada Ltd.). British Patent 1,118,850. July 3, 1968. Priority date July 18, 1966, Canada.

A reactor fuel element is described which consists of a core of U, alloyed with 2 to 7.3 wt % of Si, and a sheath of a corrosion resistant Zr alloy. The U–Si alloy core may contain minor additions of Al, C, Cr, or Fe, to reduce swelling caused by irradiation, and prior to cladding and irradiation is heat-treated at about 800°C for one to three days to transform the alloy to the delta phase, U_3Si. The core has a high density, good dimensional stability, and resists corrosion by water at 300°C. (P.G.C.)

43643 A SOL-GEL PROCESS FOR PREPARING DENSE FORMS OF PuO_2. Lloyd, M. H.; Haire, R. G. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Nucl. Appl., 5: 114-22(Sept. 1968). (ORNL-P-3602).

A sol-gel process for preparing dense microspheres of PuO_2 was developed. The process has three major operations: preparation of an aqueous sol, removal of water to give solid gel particles, and calcination at controlled conditions to remove volatiles and to sinter to a high density at relatively low temperatures (1100 to 1200°C). The plutonia sol is prepared by precipitating the hydrous oxide from a nitrate solution with ammonium hydroxide. After it is washed, the hydrous oxide is peptized by the addition of nitric acid to give a nitrate-rich plutonia sol containing a nitrate/plutonium ratio of ≥1. The nitrate concentration is lowered by drying and baking the sol. The residue is then resuspended in water to give a dilute sol, which is concentrated by evaporation to the desired plutonium concentration. The sols produced by this procedure are 1 to 3 $\underline{M}$ in plutonium concentration and have NO_3^-/Pu mole ratio of 0.1 to 0.15. They are stable for several months and compatible with low-nitrate thorium and uranium sols. Dense homogeneous microspheres of plutonia, plutonia-urania, and plutonia-thoria were produced at desired ratios on a pilot plant scale. (auth)

43644 PREPARATION OF SPHERICAL PARTICLES. Smith, Jean Gillen; Flack, Herbert Paul (to W. R. Grace and Co.). British Patent 1,122,412. Aug. 7, 1968. Priority date Sept. 23, 1964, United States.

A process for preparing spherical particles of a substance, which comprises at least one oxide and which can be dispersed as an aquasol, consists of mixing an aquasol of the substance with H_2O_2, forming a dispersion of the mixture in a liquid medium, such as hexanol, ethyl hexanol, or ethyl butanol, in which water has low solubility, and allowing the dispersed droplets to remain in contact with the liquid medium until water is extracted from them by the liquid medium and they are solidified into spherical particles. The process is applicable to the production of spheres of actinide metal oxides, zirconia, and yttrium oxide. (B.L.M.)

43645 EFFECT OF Cu ADDITIONS ON SOME PROPERTIES OF 50 WC–15 TiC–5 TaC–30 Co ALOYS. Suzuki, Takuya; Kimura, Takao (Furukawa Electric Co., Ltd., Tokyo). Nippon Kinzoku Gakkaishi, 32: 424-9(1968). (In Japanese).

For the purpose of developing a high-strength TiC- and Co-rich WC–TiC–TaC–Co alloy, 0.015 to 3.29% Cu was added to 50 WC-15 TiC-5 TaC-30 Co alloys, and the effects on the density, particle size, and mechanical properties were studied. Alloys were prepared by ball milling Cu and TiC together and then by adding this dried mixture to the other components, followed by a further ball milling. It was found that the density increases upon addition of 0.015% Cu and reaches a maximum at approximately 0.3 to 1% Cu. A further addition decreases the density. The average carbide particle size decreases and then becomes minimum at the corresponding concentrations. A 3.29% Cu addition increases the particle size. A certain amount of Cu added inhibits the growth of (W, Ti, Ta) C particles but has no effect on those of the other carbide particles. The change in carbide-liquid metal wettability due to the Cu addition was considered responsible for the enhancement of density and the reduction of particle size. The behavior of transverse rupture strength is closely related to those of density and particle size. The maximum strength occurs at approximately 0.3 to 1% Cu added. Similar conclusions have been reached for other compositions of the base alloys. (auth)

Properties Evaluations

Refer also to abstracts 42995, 43005–43008, 43585, 43663, 44268, and 44804.

43646 (ANL–7299, pp 220-6) ACTINIDE CERAMIC COMPOUNDS. (Argonne National Lab., Ill.).

Results of investigations are presented on antiferromagnetism of UP, defect equilibria of PuO_2, thermodynamic properties of Pu carbides, neutron diffraction by NpO_2, and magnetic susceptibilities of actinide carbides and oxides. (J.R.D.)

43647 (EUR–4035) DISPERSION STRENGTHENED ALUMINIUM FOR NUCLEAR PURPOSES, WITH PARTICULAR EMPHASIS ON CORRELATION BETWEEN CREEP STRENGTH AND MICROSTRUCTURE PARAMETERS. Gualandi, D.; Gelli, D.; Jehenson, P.; Mori, L.; Paganelli, M. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). June 20, 1967. 24p. (CONF-670909–9). Dep.

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan.

Experimental data on the creep behavior of $Al-Al_2O_3$ composites, for nuclear fuel cladding, indicate that the high mechanical strength at elevated temperatures is correlated with very reduced grain size, stable at high temperatures, due to the presence of a dispersed phase. A marked increase in creep ductility of $Al-Al_2O_3$ composites is obtained by use of Al alloyed with 2 to 5% Mg, as the starting material, to transform the dispersed phase from Al_2O_3 to a mixed oxide $MgO + MgO-Al_2O_3$. (P.G.C.)

43648 (GEAP–5634) THERMODYNAMIC DATA PROGRAM INVOLVING PLUTONIA AND URANIA AT HIGH TEMPERATURES. Quarterly Report No. 3. Aitken, E. A.; Evans, S. K. (General Electric Co., Pleasanton, Calif. Vallecitos Nuclear Center). May 1968. Contract AT(04-3)-189. 7p. Dep. CFSTI.

Melting point data for PuO_{2-x} and $U_{0.6}Pu_{0.4}O_{2-x}$ solid solutions in the hypostoichiometric region were obtained by the thermal arrest method. The data show a maximum at an oxygen-to-plutonium ratio between 1.70 and 1.80 for both compositions. The liquidus and solidus temperatures are nearly coincident for the PuO_{2-x} case and differ by about 35° for the mixed oxide composition. The melting point of PuO_{2-x} falls steeply at an oxygen-to-plutonium ratio below 1.73. The solidus temperature of $PuO_{1.61}$ was found to be 2300°C. The results on the melting behavior of PuO_{2-x} are compared with similar data for UO_{2-x}. (auth)

43649 (RD/B/N–941) INFLUENCE OF SPECIMEN GEOMETRY AND STRUCTURE ON THE IMPACT RESISTANCE OF SILICON CARBIDE. Ashford, J. P.; Priddle, E. K. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). May 1968. 37p. Dep. CFSTI.

Work to determine the impact resistance of SiC at room temperature and 1000°C is described. Samples of SiC were selected for testing that would fracture according to two different criteria: stored energy, and Hertzian contact stress. The literature is extensively reviewed for impact failure mechanisms, but other appropriate work on SiC was found to be sparse. Equations are developed that describe the main impact resistance criteria, and the influence of micro-structure on impact cracking is discussed. (auth) (UK)

43650 (SU–283-6) THERMODYNAMIC PROPERTIES AND DEFECT STRUCTURE OF INTERMETALLIC COMPOUNDS. Progress Report, May 1, 1967–May 31, 1968. Stevenson, David A. (Stanford Univ., Calif. Dept. of Materials Science). June 1968. Contract AT(04-3)-283. 33p. Dep. CFSTI.

A progress report describing work in progress but not completed on growth and electrical and optical properties of ZnTe, self diffusion in ZnSe, and the high temperature defect structure of CdTe. (P.G.C.)

43651 (TRG-Report–1601) PHYSICAL PROPERTIES OF SOME PLUTONIUM CERAMIC COMPOUNDS: A DATA MANUAL. Seddon, B. J. (comp.) (United Kingdom Atomic Energy Authority, Risley (England). Reactor Group). Dec. 18, 1967. 54p. Dep. CFSTI. UK 8s.

The best available data on the physical properties of plutonium compounds of interest as fuel materials are tabulated. These are the dioxide, monocarbide, mononitride, monosulphide and monophosphide of Pu, $(UPu)O_2$, (UPu)C, (UPu)N, and the Pu silicides. (auth) (UK)

43652 (UCRL–50337) FATIGUE BEHAVIOR OF EP-1924 GRAPHITE AND A GENERALIZED DESIGN CRITERION. Leichter, H.; Robinson, E. (California Univ., Livermore. Lawrence Radiation Lab.). Oct. 24, 1967. 30p. Dep. CFSTI.

The fatigue behavior of EP-1924 graphite was investigated in reverse bending up to 5×10^6 cycles at room temperature. A statistical analysis was made of fatigue life using a Weibull distribution and a homologous stress. The homologous stress is the ratio of applied stress in fatigue to the expected first-cycle strength. The first-cycle strength was calculated from the bending tests of similar material or "mate" specimens using the Weibull theory for correction of the significant size effect. Homologous stress gives a good correlation of life with stress for a wide variety of graphite grades and is thus recommended for the estimation of survival probability. The endurance limit for EP-1924 graphite was found to correspond to a homologous stress with other published data. (auth)

43653 MISCIBILITY OF CUBIC MULTICOMPONENT CARBIDES. Kieffer, R.; Nowotny, H.; Neckel, A.; Ettmayer, P.; Usner, L. (Technische Hochschule, Vienna. Univ., Vienna). Monatsh. Chem., 99: 1020-7(May–June 1968). (In German).

The miscibility gap within the systems: $TiC-\{ZrC, HfC\}$ and $VC-\{NbC, TaC\}$ was experimentally determined in the region from 1200°C up to the temperature of the critical point. A calculation of the binodal curve was carried out by means of an excess free enthalpy of the form: $\Delta G^E = x(1-x)\{(a_0 + a_1 T) + (2x-1)(b_0 + b_1 T)\}$. (auth)

43654 POWDER METALLURGY CRUCIBLE MATERIALS FOR THE MELTING AND EVAPORATION OF METALS. Kotsch, Heinz. Neue Huette, 12: 350-5(June 1967). (In German).

The suitability of carbides, borides and nitrides for use as containment materials of molten metals is surveyed on the basis of wetting ability. The resistance to metals, as a function of time and temperature, is tabulated for SiC, TiC, Cr_3C_2, Mo_2C, W_2C and WC against Fe, Ni, Co, Mn, Cu, Al, Sn–Bi, Pb–Cd, SiO_2 and MnO_2; for ZrB_2, ZrB_2 + B, TiB_2 and TiB_2 + 10% B against Cu, Ag, Al, Sn, Fe, Co and Ni; and for AlN, TiN, ZrN, NbN, Cr_2N and CrN against Fe, Co, Ni, Ni-Cr (80/20), Cu and Al. The effect of various molten metals, salts and slags on oxynitride-bonded SiC is presented and the properties of a large number of substances in contact with molten metals are discussed. (Rev. Metal Lit.)

43655 ANISOTROPY FACTORS OF POLYCRYSTALLINE GRAPHITES. Reynolds, W. N. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Carbon, 6: 277-82(June 1968).

The x-ray anisotropy functions of polycrystalline graphites are related to the coefficients of thermal expansion, the conductivities, and the Hall effects, by a single parameter. This leads to some important conclusions regarding the analysis of dimensional changes in polycrystalline materials at high crystal strains. The elastic constants are related to the anisotropy function via two parameters. It is shown that these may be determined from the magnetoresistivities. (auth) (UK)

43656 THERMAL CONDUCTIVITY OF SX-5 GRAPHITE. Wagner, P.; Dauelsberg, L. B. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. Carbon, 6: 373-80(June 1968). (LA-DC-8630).

Measurements of the thermal conductivity of SX-5 graphite from –100 to 2500°C are reported. This temperature range was covered by three techniques: a transient technique at the lower temperatures, a series-comparison method for the intermediate range, and a radial heat flow method for the high temperatures. The radial heat flow method, when used with anisotropic materials, requires a two-dimensional heat flow analysis of the data; the approach used in this work is described. At temperatures above 250°C the conductivity appears to follow a 1/T relation, which is characteristic of graphites in particular and of Umklapp thermal resistive processes in general. (auth) (UK)

43657 ELECTRIC CONDUCTIVITY OF AMORPHOUS AND ALPHA–URANIUM TRIOXIDE. Shalaginov, V. N.; Beketov, A. R.; Vlasov, V. G.; Drugov, V. G. Tr. Ural. Politekh. Inst., 148: 63-7(1966). (In Russian).

Changes in electrical conductivity represent a sensitive method of detecting structural changes in UO_3 under vacuum and CO atmospheres (P_{CO}= 200 mm Hg std). The electrical conductivity σ increases linearly with increasing temperature to 380 to 390°C for UO_3 (amorph.) and to 430 to 440°C for alpha-UO_3 under vacuum conditions. In a CO atmosphere, the uranium trioxides are less stable. The reduction of alpha$-UO_3$ begins at 250°C in CO. Also, inflection points were detected at 320°C (composition of $UO_{2.80}$), 380°C ($UO_{2.76}$), 490°C ($UO_{2.58}$), 560°C ($UO_{2.25}$), and 640°C ($UO_{2.0+}$). At temperatures above 450°C, conversion of amorphous UO_3 to crystalline alpha$-UO_3$ becomes noticeable. Crystallization is accompanied by a loss of oxygen which ceases at a composition close to $UO_{2.97}$. The reduction of amorphous UO_3 in a CO atmosphere gave a series of oxide phases similar to those described above. (TTT)

43658 RELATIONS BETWEEN PROPERTIES OF WC–TiC–NbC–10 PERCENT Co ALLOYS AND CARBON CONTENT. Suzuki, Hisashi; Hayashi, Kozi; Kawakatsu, Ichiro (Tokyo Univ.). Nippon Kinzoku Gakkaishi, 32: 448-53(1968). (In Japanese).

Fundamental properties of various WC$-$TiC$-$NbC$-$10% Co alloys (vacuum-sintered at 1400°C for 1 hr) were studied in relation to their carbide compositions and carbon contents, and the results were compared with those of previously prepared WC$-$TiC$-$TaC$-$Co alloys (WTT alloys). It was found that the amount of dissolved W in the γ phase which depends on the carbon content was considered to be the same as in WC$-$Co, WTT alloys, and Nb and Ti hardly dissolved in the γ phase as Ta and Ti in WTT alloys. The total variation of the carbon content of the β_t' phase (WC$-$TiC$-$NbC solid solutions) in the (WC + β_t' + γ) three-phase region increased with increasing niobium carbide content up to 60% in the β_t' phase, contrary to the case of WTT alloys (the total carbon variation decreased with increasing tantalum carbide content). The width of the three-phase region extended with increasing titanium carbide and niobium carbide contents (the width of the three-phase region of WTT alloys depended mainly on the titanium carbide content). The transverse-rupture strength of the alloys lowered with increasing total amounts of titanium and niobium carbides, in contrast with the strength of WTT alloys which was mainly affected by the titanium carbide content. Thus, the strength was much inferior to that of WTT alloys. The change in lattice parameter of the β (70 WC$-$30 TiC solid solutions)$-$NbC system obeyed Vegard's law as confirmed in the $\beta-$TaC system. Properties of the alloys such as magnetic saturation, specific gravity, hardness, and transverse-rupture strength, varied regularly with the carbon content in the same way as the other cemented carbides as well as WTT alloys. (auth)

Structure and Phase Studies

43659 (ANL-Trans-654) THE MICROCALORIMETRIC STUDY OF THE UF_4–UF_6 SYSTEM. Barberi, Paul; Hartmanshenn, Olivier (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Translated by Betty Guttman (Argonne National Lab., Ill.), from report CEA-N-916. 15p. Dep. CFSTI.

The microcalorimetric study of the UF_6-UF_4 system was undertaken in the temperature range 26 to 200°C under various pressures of UF_6. The following conclusions were made. (1) The domains of fluoride stability defined by the Agron diagram was verified. (2) The heat and gravimetric balances, as well as the Debye and Sherrer x-ray diffraction, show that the final product of the UF_6-UF_4 reaction at a temperature of 26° is β UF_5, contrary to the results of Nghi. (3) There is only an apparent contradiction between the results of the thermal differential analysis of Nguyen-Hoang-Nghi and the results reported here. The UF_4 sample seems a little more reactive, and this could not be attributed to a little lower purity, a different specific surface, a much higher pressure of UF_6, or any other reason. It was found that the intermediate fluoride (U_4F_{17} or U_5F_{22}) was formed, and this was confirmed by x-ray diffraction. (4) The AHD peaks that were obtained in the 30 to 80°C zone by the linearly programmed rise in temperature or by successive temperature steps can be attributed to a maximum of the "majority" reaction onto which certain others are simultaneously superimposed; these exhibit a heat-balance that differs little, and a maximum which may either be before or after the major one. On the other hand, beyond 110 to 120°C the localization of the AHD peaks becomes more useful as well as more significant. The reasons for the difficulty in examining the differential enthalpic analysis below 80°C lie in the slow kinetics of diffusion of fresh UF_6 through the layer of formed UF_x. (auth)

43660 (NAA-SR-Memo-11849) STUDIES OF TERNARY METAL–NONMETAL–HYDROGEN SYSTEMS. Korst, W. L. (Atomics International, Canoga Park, Calif.). May 1, 1967. 13p. Dep. CFSTI.

Evidence that hexagonal ternary compounds are formed in various M$-$C$-$H systems, where M represents various transition metals, suggested the examination of Zr$-$X$-$H systems, where X represents B, C, N, O, and Si. The existence of a hexagonal ternary compound, $ZrC \cdot ZrH_x$, has been confirmed, and similar compounds have been discovered in the Zr$-$N$-$H and Ti$-$N$-$H systems. The hexagonal ternary compound, $ZrN \cdot ZrH_x$, has since been reported in the literaure. The hexagonal ternary phases can apparently only be formed by refractory compounds having a high degree of hypostoichiometry. Literature reports indicate that absorption of hydrogen to form such compounds occurs more readily under high pressures of hydrogen. Reports have also appeared concerning absorption of hydrogen directly into hypostoichiometric fcc MC_{1-x} phases, with retention of the fcc lattice; these cubic ternary phases are reported to exist in equilibrium with the hexagonal ternary phases. (auth)

43661 BEHAVIOR OF Dy_2O_3 DISPERSIONS IN W, ZrO_2, AND UO_2 AT HIGH TEMPERATURE. Kubota, Tadashi; Komine, Isao; Takahashi, Shuichiro (Mitsubishi Atomic Power Industries, Inc., Omiya, Japan). Nippon Genshiryoku Gakkaishi, 10: 384-9(1968). (In Japanese).

Dispersions of Dy_2O_3 in W, ZrO_2 (CaO stabilized), and UO_2 were subjected to steep temperature gradients at near melting temperature of the respective matrixes, to determine the compatibility of Dy_2O_3 with W, ZrO_2, and UO_2. It was found that Dy_2O_3 is compatible with W up to 2,300°C, however, the Dy_2O_3 migrated and agglomerated in the central region and became one sintered block. In the case of $Dy_2O_3-ZrO_2$, the Dy_2O_3 particles were no longer visible in the central region where the temperature was above 1,900°C; they had formed a solid solution with ZrO_2. X-ray diffraction analysis applied to the massive grain region of $Dy_2O_3-UO_2$, where temperature was above 1,900°C, revealed that Dy_2O_3 had formed a solid solution with UO_2. (auth)

43662 ELECTRON MICROSCOPY OF PYROLYTIC GRAPHITE. Gillin, L. M.; Kelly, A. (Cambridge Univ., Eng.). J. Mater. Sci., 3: 408-11(July 1968).

A detailed study of heat-treated and deformed pyrolytic graphite was made using transmission electron microscopy. Single-crystal characteristics were observed in material annealed at 3600°C. Tilt boundaries are shown to be kinks in the basal planes with some twin boundaries which can be described in terms of dislocations, as for natural crystals. (auth) (UK)

43663 PLUTONIUM OXIDE AS NUCLEAR FUEL. Mattys, H. M. (European Inst. for Transuranium Elements, Karlsruhe, Ger.). Actinides Rev., 1: 165-82(June 1968).

Properties of PuO_2 and PuO_2-UO_2 mixtures as a reactor fuel, phase diagram of PuO_2-UO_2, oxygen partial pressure of mixed plutonium and uranium oxides, vapor pressure of plutonium oxide, thermal conductivity of mixed oxides, diffusion in mixed plutonium$-$uranium oxides, and fuel element design are discussed. (M.C.G.)

43664 MIXED CRYSTAL FORMATION IN QUASIBINARY SYSTEMS OF UN AND THE MONONITRIDES OF GROUP IV A TiN, ZrN, AND HfN. Holleck, H.; Smailos, E.; Thuemmler, F. (Kernforschungszentrum, Karlsruhe, Ger.). Monatsh. Chem., 99: 985-9(May-June 1968). (In German).

X-ray methods were used to investigate the systems UN with nitrides of the Group IV A transition metals: TiN, ZrN, and HfN. At 2000°C the quasibinary systems UN$-$ZrN and UN$-$HfN showed complete solid solubility whereas TiN was soluble in UN from about 1 mol% at 1700°C to about 4 mol% at 2400°C. (auth)

Radiation Effects

Refer also to abstract 43613.

43665 (EURAEC-2038) STUDY OF FISSION GAS RELEASE FROM UO_2 SAMPLES IRRADIATED AT VARIOUS DOSES. Quarterly Report No. 10, January–March 1968. Baffigo, V.; Frigerio, G. (Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari). May 1968. Contract 043-65-TEEI(RD). 10p. (EUR-3988). Dep. CFSTI.

Work performed under United States–Euratom Joint Research and Development Program.

Ten diffusion experiments have been performed on UO_2 pellet specimens (density 92 to 95% T.D.) at 1400°C and 3 to 7000 MWd/t. The diffusion coefficient D′ varied from 10^{-13} to 2.4×10^{-9} sec^{-1}. The irradiation dose effect on the release data parameter of xenon, consisting in a decrease of D′ with increase of the irradiation dose, has been evaluated within 2 to 3 orders of magnitude by increasing the dose from a few MWd/t to 2000 to 3000 MWd/t. This is true both for pellets of density 92 and 95 percent of theoretical. It has been observed, however, that in more dense pellets the D′ coefficient increases after having reached a minimum at the saturation level which, on the contrary, is maintained by less dense pellets. The same behavior of dense pellets has been observed in fused UO_2. However, the difference in density (95% of pellets versus 99% of fused UO_2) seems to influence the saturation value of D′ decrease. This value has been evaluated to be a few hundreds MWd/t in fused UO_2 and a few thousands MWd/t in pellets. (D.L.C.)

43666 (EURAEC–2039) STUDY OF FISSION GAS RELEASE FROM UO_2 SAMPLES IRRADIATED AT VARIOUS DOSES. Quarterly Report No. 9, October–December 1967. Baffigo, V.; Frigerio, G. (Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari). May 1968. Contract 043-65-TEEI-(RD). 12p. (EUR–3989). Dep. CFSTI.

Work performed under United States–Euratom Joint Research and Development Program.

Eleven diffusion experiments have been performed on UO_2 specimens (fused and hot-pressed powders and grains; density, 97.9 and 99.0% T.D.) at 1400°C and 12 to 2300 MWd/t. The irradiation dose effect on the release rate parameter, consisting in a decrease of D′ with increase of the irradiation dose equal to 1 to 2 orders of magnitude, seems to occur mainly within 100 MWd/t. In very high density UO_2, an increase of D′, subsequent to the saturation of its initial decrease, has been observed. This increase seems effective already after a few hundreds MWd/t and brings practically the D′ values again to initial levels at about 2000 MWd/t. (D.L.C.)

43667 DYNAMIC MECHANICAL BEHAVIOR OF GRAPHITES. Taylor, R. E.; Kline, D. E.; Walker, P. L. Jr. (Pennsylvania State Univ., University Park). Contract AT(30-1)-1710. Carbon, 6: 333-47(June 1968).

The stress-amplitude independent internal friction and dynamic elastic modulus of pitch-bonded natural graphite crystals and various grades of commercial graphites were measured from 4 to 750°K at frequencies in the range of 0.6 to 10 kcps. The internal friction, which was an order of magnitude larger than that previously reported for as-deposited pyrolytic carbon and vitreous carbons, is primarily characterized by a broad peak (designated as the a peak) centered near room temperature, accompanied by an elastic modulus relaxation. The peak characteristics, including a reduction in peak height by annealing or low-dose reactor irradiation (4×10^{15} nvt), closely corresponded to those previously observed for the Bordoni peak in fcc metals. Similar to the suggested mechanism in metals, the a peak may be associated with the motion of basal plane dislocations. The investigation also revealed the presence of a small relaxation below 60°K in some graphites and, in one case, a very sharp peak above room temperature. It is assumed that the former may be associated with impurities. The latter peak, which anneals out, is similar in some respects to a few cited cases in metals. (auth) (UK)

43668 EFFECTS OF SOME PROCESS TEMPERATURES ON RADIATION INDUCED CONTRACTION OF GRAPHITE. Marek, R. W. (Airco Speer Research Labs., Niagara Falls, N. Y.); Parker, W. E.; Cox, J. H. Contract AT(45-1)-1350. Carbon, 6: 349-58(June 1968).

The dimensional change that occurs during the thermal processing of graphite and the subsequent dimensional change that occurs when graphite is irradiated were explored. Raw material bias was removed by fabricating seven sets of graphite from one formulation. A systematic dimensional change during processing was achieved by controlling the graphitization rate to the same final temperature. A second series of samples was used to demonstrate the degree to which binder graphitization (or binder heat-treatment) determines radioinduced dimensional change. The filler for the formulation was graphitized to 2900°C and then mixed with a graphitizable binder. Subsequently, the samples were heat-treated to temperatures appropriate for a broad range of crystallite development in the binder phase. As the crystallite size in the filler was the same, differences in radioinduced contraction could be attributed to the binder phase. The dimensional stability of both perpendicular and parallel orientations under irradiation showed a definite effect of binder graphitization. Unlike a system in which all constituents have the same graphitization temperature, however, this series did not show a uniform increase in contraction rate with decreasing graphitization temperature. There was little effect due to heat-treatment temperature down to 2000°C; at heat-treatment temperatures below 2000°C there was a sharp increase in contraction rate for both orientations. (auth) (UK)

43669 ELECTRONIC TESTING OF UO_2 PELLETS IN THE COURSE OF NEUTRON IRRADIATION. Sorriaux, Andre (INSTN, Gif-sur-Yvette, France). Compt. Rend., Ser. A and B., 266: 1451-4(June 10, 1968). (In French).

In a study of the electronic properties of UO_2, the evolution of the variations was observed during the neutron irradiation of a capsule containing some UO_2 powder. An electromotive force between the center and the periphery of the capsule was observed which is proportional to the flux of neutrons. (tr-auth)

43670 EXAMINATION OF IRRADIATED NUCLEAR FUELS. III. Lambert, J. D. B. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Energy, 66-74(May-June 1968).

Thin film electron microscopy is applied to discs of irradiated UO_2. Details are given of the slicing, trepanning, and electropolishing units employed in specimen preparation. Studies of inclusions in irradiated UO_2 and $(U,Pu)O_2$ by electron probe microanalysis, and the use of X-ray crystallographic methods to assess the effect of irradiation on UO_2 cell size, are described. Determination of fuel burn-up is discussed with reference to the experimental assessments available. (UK)

Plastics and Other Materials

Refer also to abstracts 42966, 43523, 44541, 44827, and 44917.

43671 BINDER FOR PROTECTION FROM HARD RADIATION. Fedorov, N. F.; Sychev, M. M. Stroit. Mater., 14: No. 1, 32-3(1968). (In Russian).

The production of a binder from portland cement and water-soluble salts of Sm and Cd having a large capture cross section was studied. The clinker was ground with 3 and 6 wt % gypsum to a sp gr of 3000 cm^2/g and was dissolved with 10 and 25% solutions of Cd nitrate and Sm chloride. The normal density is nearly that of cement dissolved in water. Cement with gypsum and Cd nitrate has a very short setting time. Lengthening of setting time is recommended by addition of 1.5% sulfite-alcohol slops. The setting time with 10% Sm chloride is admissible. An increase in the Sm chloride content, however, leads to immediate setting. Only 6% gypsum and 1.5% sulfite-alcohol slops produce admissible setting times. The strength characteristics are in most cases inferior to the standard values. A 10% Sm chloride solution intensifies hardening. The shielding properties are the following: thickness of a layer for half-absorption for cement stone 9.1, concrete 8.9, a 1 :3 solution of 10% solution of Cd nitrate 0.9, with 25% Cd nitrate 0.6 cm. With Sm chloride the results are even better. (auth)

PHYSICS (GENERAL)

Astrophysics and Cosmology

Refer also to abstracts 43171, 43947, 44499, and 44625.

43672 (JILA-93) ON THE EMISSION OF ATOMIC HYDROGEN IN COMETS. Biermann, L. (Joint Inst. for Lab. Astrophysics, Boulder, Colo.). Jan. 30, 1968. 13p.

If the currently accepted picture of the mass of a comet and its chemical composition is correct, comets should be surrounded by a large exosphere of hydrogen atoms escaping with a velocity of several km/sec and replenished by dissociation of the gases released from the nucleus. For typical medium-bright comets, this atmosphere should be opaque to solar Ly α quanta out to a distance from the nucleus of perhaps a million km, for Ly β quanta out to $\gtrsim$100,000 km; these estimates, however, hold only for quanta with a wavelength corresponding to the comet's radial velocity to within $\lesssim 1/20$ A (total width). Furthermore, since the profiles of the solar Lyman lines in the absence of large scale activity have a rather deep minimum in the line center, only a small fraction (perhaps 3 to 5%) of the solar flux in these lines can normally be intercepted. Owing to the large size of the sphere around the comet which is opaque to Ly α radiation, the disk defined by optical depth $\geq$1, should possess a very large luminosity, i.e., $\approx 10^{33}$ Ly α quanta per sec for a typical medium bright comet, which is about equal to the number of quanta per sec emitted in the visual and photographic range. The Ly β emission would be much weaker; it is of interest, however, because an Hα quantum would result with a 12% probability from each absorption of a Ly β quantum. This should produce an Hα emission corresponding to several times 10^7 transitions per cm^2 column and sec, depending somewhat on solar activity and the comet's radial velocity with respect to the Sun. The observation of the Hα emission would be difficult because of the low surface brightness, but it would not be entirely impossible under favorable circumstances (visibility against the night sky, large radial velocity of the comet with respect to the Sun, and/or high solar activity). (auth)

43673 FIZIKA PLANET. (Physics of Planets). Moroz, V. I. Moscow, Izdatel'stvo Nauka, 1967. 496p.

In this book an attempt is made to summarize all currently available information on the physical characteristics of the planets of the solar system as determined by high-resolution spectroscopy, radio telescopes, radar and ir techniques, and photometry. Particular attention is given to the most essential problems of current interest; the Martian atmosphere, the surface temperature of Venus and the structure of the Venusian atmosphere, the nature of the radio emission from Jupiter, and the hypothetical Mercurian atmosphere. The problems discussed in regard to Mars include: the CO$_2$ content, total pressure, and chemical composition of the Martian atmosphere; cloudiness, winds, and surface temperature; the transparency and vertical structure of the atmosphere; the polar caps, continents, and dark regions. With respect to Venus, the problems examined include: the period of revolution, albedo, phase curve, and polarization of Venus; the CO$_2$ absorption bands and CO$_2$ dissociation; the chemical composition of the Venusian atmosphere and cloud cover; the temperature of Venus determined from radiation in the optical region of the spectrum and the radio emission and vertical atmospheric structure of Venus. Information on the giant planets includes: the various phenomena observed on the disk of Jupiter, a qualitative chemical analysis of the Jovian atmosphere, a quantitative interpretation of the spectra of Jupiter (chemical composition and pressure), the temperature of Jupiter and the chemical composition of its cloud cover, the vertical structure of the atmosphere above the cloud cover, the shortwave radio emission and the magnetic field of Jupiter, and the radio emission of Jupiter at decameter wavelengths. (IAA)

43674 AN ACTIVE REGION STREAMER OF THE SOLAR CORONA. Saito, Kuniji (Tokyo Univ. Tokyo Astronomical Observatory); Owaki, Naoaki. Astron. Soc. Jap. Publ., 19: 535-49(1967).

A photometric study was made of a conspicuous active-region streamer that originated at heliographic P. A. 280° of the solar corona observed during the 1962 New Guinea eclipse. The white electron density along the axis of the streamer is obtained out of 3.5 $R_\odot$. White light polarization measurements indicate that this streamer is inclined from 15° to 20° in front of the celestial plane. Loop systems are extracted from the streamer, and their electron densities are evaluated. It is concluded that the geometry of the streamer broadens out in space in contrast with the visual impression. (IAA)

43675 H-ALPHA STRUCTURES IN GROUPS OF SUNSPOTS. Bruzek, Anton (Institut fuer Sonnenforschung, Freiburg i. B.). Sterne Weltraum, 7: 88-91(Apr. 1968). (In German).

Four different types of structure observed in sunspot and flare regions were studied with the aid of Hα photographs. The structures investigated include long streaks, "channels," curved filaments, and bright points. Photographs of all four types are presented, and such details as duration and positioning of these structures are discussed. It is pointed out that the nature of the solar bright points is still unclear. (IAA)

43676 A STUDY OF STELLAR ROTATION. I. RECOGNITION OF A DISTINCT GROUP OF SLOWLY ROTATING B2 TO F2 MAIN-SEQUENCE STARS. van den Heuvel, E. P. J. Bull. Astron. Inst. Neth., 19: 309-25(Mar. 1968).

All data on stellar rotation published up to the end of 1966 are examined. The Ap and Am stars, most of which are slow rotators, are omitted. The ν_e sin i distributions for O5 to F5 stars of luminosity class III, IV, and V show the following characteristics: (1) between B2 and about A4 the ν_e sin i distributions show two maxima, one at 0 to 45 km/sec and one at $\nu_e \sin i \geq 90$ km/sec ("slow" and "rapid" rotators); (2) practically no slow rotators occur between A5 and F2 (where the classical Am stars occur) and for luminosity class V also few slow rotators occur between B5 and A1 (just where most of the Ap stars are concentrated). Evidence that the groups of slow rotators and rapid rotators are probably real is examined. When Ap and Am stars are included, the group of slow rotators contains for all spectral types between B2 and F2 about 25 ± 6% of the luminosity class IV and V stars. The above conclusions remain valid if only stars brighter than $m_v = 5^m.5$ are considered. A number of arguments are presented which indicate that the Ap stars and Am stars form a single group with the other slowly rotating A- and B-type main-sequence stars. In particular, just like the Ap stars, the slowly rotating B2-B9.5 IV, V stars show a rather low percentage (16 to 23%) of recognized spectroscopic binaries, while just like the Am stars the slow rotators later than AO show a fairly large (>40%) percentage of spectroscopic binaries. On the other hand, the group of rapid rotators is found to consist of normal stars with a rather high (33%) percentage of recognized spectroscopic binaries. Tabulated data on stellar types, classifications, distributions, etc, are given. (IAA)

43677 A STUDY OF STELLAR ROTATION. II. THE ORIGIN OF Ap AND Am STARS AND OTHER SLOWLY ROTATING A- AND B-TYPE MAIN-SEQUENCE STARS. van den Heuvel, E. P. J. Bull. Astron. Inst. Neth., 19: 326-51(Mar. 1968).

Suggestion of a similar origin for Ap and Am stars and for most of the other stars in the group of B2-F1 IV, V slow rotators was found in a previous paper (Van den Heuvel, 1968). The tendency of Ap and Am stars in clusters to be blue stragglers or close to the Zero Age Main Sequence, their normal masses and surface gravities for stars on the main sequence, and their slow rotation and abnormal percentages of spectroscopic binaries can all be explained if these stars were originally the less massive members in spectroscopic binaries in which the primary during its post-main-sequence evolution filled its Roche lobe, transferred a large fraction of its mass toward the secondary, and finally evolved into a white dwarf. Also other characteristics of Ap and Am stars summarized in a table and discussed are in agreement with this evolutionary hypothesis. For double-lined Ap and Am systems, in which both components always show the abnormal spectrum, the presence of an evolved third component is suggested. The change in binary period as a consequence of mass exchange is considered. Since after the mass exchange the evolved primary is a star of low mass, a degenerate core and flashes are expected to occur in its interior, and heavy-element synthesis is expected to take place in the way outlined by Fowler et al. (1965). (IAA)

43678 SEARCH FOR PULSATING RADIO SOURCES IN THE DECLINATION RANGE $+44° < \delta < +90°$. Cole, T. W.; Pilkington, J. D. H. (Cambridge, Univ., Eng.). Nature (London), 219: 574-6 (Aug. 10, 1968).

Two further pulsating radio sources have been discovered by Cambridge radio astronomers. (auth)(UK)

43679 NEW PULSATING RADIO SOURCE. Huguenin, G. R.; Taylor, J. H.; Goad, L. E.; Hartai, A.; Orsten, G. S. F.; Rodman, A. K. (Harvard Coll. Observatory, Cambridge, Mass.). Nature (London), 219: 576-7(Aug. 10, 1968).

Harvard radio astronomers have discovered a new pulsating radio source with a pulse repetition period of 0.73968 ± 0.00002 s. (auth)(UK)

43680 PULSATION PERIODS OF ROTATING WHITE DWARF MODELS. Ostriker, J. P.; Tassoul, J.-L. (Princeton Univ., N. J.). Nature (London), 219: 577-9(Aug. 10, 1968).

For rapidly rotating white dwarfs one fundamental axisymmetric mode may have a period of pulsation lower than 0.25 s. (auth)(UK)

43681 CALCULATION OF STELLAR STRUCTURE. Rouse, C. A. (Naval Research Lab., Washington, D. C. Univ. of California, Berkeley). Progr. High Temp. Phys. Chem., 2: 97-126 (1968).

A method of calculation is reviewed, with consideration only of the structure of the Sun, based upon a real gas equation of state that describes a mixture of monatomic gases in ionization equilibrium. Headings are as follows: Introduction; basic equations; physical input (equation of state, adiabatic changes in an ionizing gas, opacity, energy generation); results; discussion (stability conditions derived from real gas properties, mass-central density relationship, results with improved programs). (UK)

43682 TWO REMARKABLE GALAXIE TRIPLETS. Richter, L.; Richter, N. Monatsber. Deut. Akad. Wiss. Berlin, 9: 658-63(1967). (In German).

Two remarkable galaxy triplets which were found in the area of the Tautenberg area plane for astrophysical statistics are reported. The dependence of the measured galaxy brightnesses on the boundary brightness of the plates was measured in the U, B, and V color systems. In the U color system no dependence was found and in the B system only a very slight dependence. In the V system however there is a very sharp and considerable dependence. The explanation for these results is discussed. (J.S.R.)

43683 QUASISTELLAR OBJECT WITH JET OR STAR PLUS GALAXIE? Richter, N. Monatsber. Deut. Akad. Wiss. Berlin, 9: 663-6(1967). (In German).

A stellar object with sharp beams was found northeast of the spherical mass M3. It could be a genuine quasi-stellar object with real jet or it could be a chance prospective projection of a galaxy at a star seen from the side so that this galaxy appears to grow out from the center of the star. These possibilities are discussed on the basis of data obtained from plates of the 1.32-meter Schmidt camera of the 2-meter universal mirror telescope of Tautenberg. (J.S.R.)

43684 ATOMIC COLLISIONS AND LOCAL THERMODYNAMIC EQUILIBRIUM IN STELLAR ATMOSPHERES. Pagel, B. E. J. (Royal Greenwich Observatory, Eng.). Proc. Roy. Soc. (London), Ser. A, 306: 91-118(July 30, 1968).

Theoretical and observational evidence for the role of collisions with electrons and neutral atoms in establishing the populations of atomic energy levels in stellar atmospheres are reviewed, with special reference to the problem of defining the range of validity of the approximation of local thermodynamic equilibrium. The discussion refers to stellar continuous spectra, absorption lines, and emission lines believed to come from extended envelopes surrounding certain hot stars. (auth) (UK)

43685 CORRELATION BETWEEN SOLAR ACTIVITY AND BRIGHTNESS OF JUPITER'S GREAT RED SPOT. Argyle, E. (Dominion Radio Astrophysical Observatory, Penticton, British Columbia). Nature (London), 219: 474(Aug. 3, 1968).

Comment is made on the "pronounced correlation" claimed by Graf et al. (Nature, 218: 857(1968)) between Zurich sunspot numbers and the relative brightness of the Jovian red spot. It is considered that a relationship between the two phenomena remains unestablished, pending better correlations. (UK)

43686 RELATIVISTIC PHENOMENA BY OBSERVATION OF NONTHERMAL COSMIC SOURCES. Ozernoy, L. M.; Sazonov, V. N. (Lebedev Inst. of Physics, Moscow). Nature (London), 219: 467-9(Aug. 3, 1968).

Study of relativistic effects in the radiation from astrophysical sources and the possibility of observational tests may throw some light on the nature of the energy sources of quasars and radio galaxies. (auth) (UK)

43687 DECREASE IN THE INTENSITY OF HYDROGEN LINES IN THE SOLAR CHROMOSPHERE. Henze, W. (High Altitude Observatory, Boulder, Colo.). Nature (London), 219: 599(Aug. 10, 1968).

Reference is made to an attempt to explain the decreasing intensities of the high Balmer and Paschen lines in the solar atmosphere by a theory for the H atom which includes a complete screened Coulomb potential (Rouse, Nature, 212: 803(1966); Phys. Rev., 163: 62(1967)). This theory takes account of the fact that the volume occupied by a H atom, and thus the maximum possible value of the principal quantum number n, is limited by the presence of nearby atoms. Although this limiting value of n is expected to apply to the chromosphere, it is questioned whether present chromospheric observations confirm the theoretical limit on n and whether the variation of the high chromospheric hydrogen lines is anomalous. (UK)

43688 SYNCHROTRON SPECTRA ASSOCIATED WITH HARD ELECTRON SPECTRA. Manely, O. P. (American Science and Engineering, Inc., Cambridge, Mass.). Nature (London), 219: 601-2(Aug. 10, 1968).

It has been found that the radio emission from Sco X-1 is consistent with the synchrotron model proposed by the author (Astrophys. J., 144: 1253(1966)). The x-ray and optical portions of the spectrum of Sco X-1 are known to vary with regard to both amplitude and spectral shape (color), and it is considered likely that some such behavior may also be found in the rf region of the spectrum. In order to facilitate interpretation of future relevant data the calculated synchrotron spectra generated by a variety of hard electron spectra are considered (power law distributions with exponents lying between zero and unity). Conservation laws require that such electron spectra do not extend to indefinitely high energies, and must therefore have a high energy cutoff. It is noted that, apart from a possible scale factor, at high frequencies the shape of the spectra is independent of the power law index, and it follows that sporadic changes in the electron energy distribution in which the high-energy cutoff remains fixed will give rise only to amplitude changes in the high-frequency region; at lower frequencies both amplitude and color changes will occur. (UK)

43689 JETS IN QUASI-STELLAR OBJECTS. Noerdlinger, P. D. (Univ. of Iowa, Iowa City). Nature (London), 219: 595 (Aug. 10, 1968).

Reference is made to the interesting suggestion that the line spectrum from quasars could arise from a jet aimed towards the observer (McCrea, Nature, 218: 257(1968)). This kind of model was stated to avoid the intergalactic absorption of Lyman α from 3C9 predicted by Gunn and Peterson (Astrophys. J., 142: 1633 (1965)) if the density of neutral intergalactic hydrogen at $z = 2$ is of the order of 10^{-11} cm^{-3} or more. The present communication argues that this still leads to difficulties with Lyman α absorption of the type predicted by Gunn and Peterson, and an alternative model is proposed. (UK)

43690 DISTANCES, SPACE DISTRIBUTION, AND LUMINOSITY FUNCTION OF QUASI-STELLAR OBJECTS. Arakelian, M. A. (Byurakan Astrophysical Observatory, Armenia, USSR). Nature (London), 219: 595-7(Aug. 10, 1968).

A statistical study of quasar distances and space distribution is described, the objects having a Poisson distribution in infinite space, and assuming that red shifts are cosmological. Schmidt's list of 33 QSO's from the revised 3C catalog was used for statistical tests. Luminosity functions were determined. Discrepancies with Schmidt's results are discussed. (UK)

43691 INDEX OF SOLAR RADIO BURST ACTIVITY AT 10.7 cm. Basu, D. (National Research Council of Canada, Ottawa). Nature (London), 219: 597-9(Aug. 10, 1968).

The significant role of microwave radio bursts in solar and geophysical studies has led to the evaluation of an index of radio burst activity at 10.7 cm to supplement already existing indices of solar activity. The parameter chosen for the index is the excess energy emitted from the Sun during a radio burst. This is measured at a particular frequency from that part of the radiation which is in excess of the steady flux before commencement of the radio event. The excess energy, expressed in units of 10^{-20} J m^{-2} Hz^{-1}, can be evaluated either from the original records by graphical integration or, more conveniently, from the published data by multiplying together the mean value of the flux for each burst and its duration. The sum of this quantity at a particular frequency for all events observed during a day, normalized by the daily period of observation, gives the value of the index for that day and frequency. The index corresponds to the HAO flare index, which is a measure of the energy emitted each hour by the Sun in H_α during flares, and to Sawyer's improved form. A second quantity, termed the "burst incidence," is considered for purpose of comparison; this is defined, for a particular frequency, as the number of bursts observed per hour, and corresponds to "flare incidence" in optical observations. The period chosen for investigation was March 1961 to December 1967. Results are shown nomographically, and are discussed. General correspondence between the various indices was found. Correlations are discussed. (UK)

43692 PLANETARY MAGNETIC FIELDS AS A TEST OF THE DYNAMO THEORY. Runcorn, S. K. Geophys. J. Roy. Astron. Soc., 15: 183-9(June 1968).

The negative results of the efforts to detect the main magnetic fields of the Moon, Mars, and Venus by space vehicles and the inference from radio noise received from Jupiter that this planet alone has a magnetic field, provides an interesting challenge for the dynamo theory. These findings were reviewed by Kern & Vestine (1963) and by Hide (1966), but they are now considered in relation to data and theories on the existence of electrically conducting cores in these planets. It is shown that the dynamo theory of the generation of a magnetic field from a turbulent fluid core predicts the existence of irregularities in the rotation of the planet's mantle—an observation which has been made for the Earth and probably for Jupiter. (auth) (UK)

43693 TIME SCALE FOR CREATION. Sandage, Allan. pp 75-112 of Galaxies and the Universe. The Vetlesen Symposium held at Columbia University, October 19, 1966. Woltjer, Lodewijk (ed.). New York, Columbia University Press, 1968.

From Symposium on Galaxies and the Universe, New York. See CONF-661064.

The discoveries of radioactivity, the principles of stellar evolution, and the expansion of the Universe provide separate approaches to the time-scale problem, and current clues suggest that all three will eventually yield the same result. The present state of each of these matters is reviewed, and the steps which seem necessary to improve the present data are outlined. (W.D.M.)

43694 SOME RECENT RESULTS OF X-RAY ASTRONOMY. Rossi, Bruno. pp 53-73 of Galaxies and the Universe. The Vetlesen Symposium held at Columbia University, October 19, 1966. Woltjer, Lodewijk (ed.). New York, Columbia University Press, 1968.

From Symposium on Galaxies and the Universe, New York. See CONF-661064.

The x-ray and optical observations on Sco X-1 are summarized and the experiments which determined the angular diameter and position are reviewed. A model for the source based on the optical identification of the 13th magnitude blue star is discussed. Further experiments thought to be helpful in further refining the model are mentioned. (W.D.M.)

43695 SPIRAL STRUCTURE IN GALAXIES. Lin, C. C. pp 33-51 of Galaxies and the Universe. The Vetlesen Symposium held at Columbia University, October 19, 1966. Woltjer, Lodewijk (ed.). New York, Columbia University Press, 1968.

From Symposium on Galaxies and the Universe, New York. See CONF-661064.

A theory based on the concept of density waves, of the type first proposed by Bertil Lindblad more than 25 years ago, is presented. Both Bertil and P. O. Lindblad made extensive investigations of orbits of individual stars to find tendencies to form density waves. These orbits were followed for a group of 192 stars by using modern computing facilities. In contrast, the present theory is a direct treatment of the collective modes by using the usual statistical formulation of the principles of stellar dynamics. Only the main ideas and results are outlined and their significance is discussed in relation to observations. (W.D.M.)

43696 RADIO ASTRONOMICAL STUDIES OF THE GALACTIC SYSTEM. Oort, Jan H. pp 1-32 of Galaxies and the Universe. The Vetlesen Symposium held at Columbia University, October 19, 1966. Woltjer, Lodewijk (ed.). New York, Columbia University Press, 1968.

From Symposium on Galaxies and the Universe, New York. See CONF-661064.

The large-scale distribution and the motion of the interstellar gas in a spiral galaxy are the problems considered in this paper. For the present the observations of extragalactic systems are rather restricted, in particular as regards motions. It is therefore important to study the Milky Way, which is so much closer. Radio astronomical studies of the gas motion in the Milky Way are summarized. (W.D.M.)

43697 GALAXIES AND THE UNIVERSE. The Vetlesen Symposium held at Columbia University, October 19, 1966. Woltjer, Lodewijk (ed.). New York, Columbia University Press, 1968. 126p. $6.00. (CONF-661064).

This volume contains the 1966 Vetlesen lecture, given by Professor Oort and the other three invited lectures given at the symposium. Separate abstracts were prepared for all four papers. (W.D.M.)

For abstracts of individual papers see: 43693–43696.

43698 RELATION BETWEEN SUNSPOT CYCLES AND MASS MORTALITY AMONG VERTEBRATES AND NONVERTEBRATES DUE TO PARASITIC ACTIVITY. Szidat, Lothar. Z. Parasitenk., 30: 1-17(Jan. 9, 1968). (In German).

Data on sunspot cycles are presented and their influence on plant and animal species is discussed. For example, the 11-yr cycle of solar activity correlates with the width of the annual rings of tree trunks over thousands of years. This report describes the effect, examined over a 40-yr observation period, on animal communities of the drought years which occur at the minimum of sunspot activity, and the occurrence of catastrophic mass mortality among vertebrates and nonvertebrates due to the proliferation of pests and their larvae during these years of drought. During these years the smaller waterholes dry out and the vertebrates which live there, chiefly amphibians and birds, migrate to the ponds and lakes which still contain water. Their droppings, added to those of the existing population, increase the number of parasite eggs excreted. Because of the higher temperatures at the minimum, the intermediate hosts in these waters multiply and, moreover, carry a particularly large burden of the intermediate stages of the parasites. These heavily infested intermediate hosts add year by year to the population of adult worms in the final hosts, so that during the postminimum period the parasite population rises to an intolerable level and results in catastrophic mortality among their intermediate hosts and subsequently among their final hosts. With the onset of the rainy period at the maximum of solar activity, the dry waterholes fill up but contain few carriers, so that the returning vertebrates, chiefly birds, are able to rear parasite-free broods and the population is restored to normal. Examples are given of catastrophic mortality at the minimum of the relative curve of solar activity. (BBB)

43699 CHANGE IN THE RADIO EMISSION FLUX DENSITY OF CASSIOPEIA A. Sanamyan, V. A.; Aslanyan, A. M. Astrophysics (Engl. Transl.), 1: 136-7(Apr.-June 1965).

Translated from Astrofizika, 1: 247-50(1965).

During the last two years repeated measurements of the radio emission fluxes of Cas A and Cyg A were made at 4.2, 3.6, and 1.5 m. The results confirm earlier conclusions (Sanamyan and Aslanyan, 1962) on the decreasing flux from Cas A and, at the same time, supplement and quantitatively refine the earlier data. (W.D.M.)

43700 COLOR FUNCTION OF YOUNG OPEN CLUSTERS. Dluzhnevskaya, O. B. (Shternberg State Astronomical Inst., USSR). Astrophysics (Engl. Transl.), 1: 130-34(Apr.-June 1965).

Translated from Astrofizika, 1: 235-46(1965).

As a development of Usher's work, the evolutionary sequences of theoretical color functions were computed for open clusters having ages from 0 to 10^8 years assuming: (a) evolution with a constant mass and (b) evolution with loss of mass. The derived relationships are compared with the observed color functions for seven young open clusters in the $(B-V)_0$ interval from 0.30 to 0.0. Despite the fact that, in the general case, the curves of family (b) agree better than curves (a) with the color functions of clusters and even give a cluster age close to current estimates obtained by other methods, the agreement between the theoretical and observed color functions cannot be considered satisfactory for both cases. The apparent cause of the disagreement is incorrectness of the hypothesis of constancy of the star-forming function, on which both evolutionary hypotheses are based. (auth)

43701 FAINT BLUE STARS IN THE REGION $\alpha = 17^h18^m$, $\delta = +43°30'$ (1950). Saakyan, K. A.; Mnatsakanyan, R. G. Astrophysics (Engl. Transl.), 1: 128-9(Apr.-June 1965).

Translated from Astrofizika, 1: 229-34(1965).

Twenty-eight faint blue ($B - V < +0.1^m$) stars to the 19th magnitude were discovered in a region with an area of 2.5 square degrees not far from the globular cluster M 92. The stellar magnitudes of these stars were measured on plates obtained using the 2-m telescope of the Tautenburg Observatory. The mean density per square degree is 10. This result agrees well with the counts of Haro and Luyten. It is extremely probable that a large part of such blue stars belongs to the population of the spherical subsystem. (auth)

43702 ELECTRON TEMPERATURE AND ELECTRON CONCENTRATION OF THE PLANETARY NEBULA IC 4997. Gurzadyan, G. A. Astrophysics (Engl. Transl.), 1: 126-7(Apr.-June 1965).

Translated from Astrofizika, 1: 225-8(1965).

New data on the relative intensities of the forbidden lines of twice ionized neon were used to determine the electron temperature and electron concentration for the planetary nebula IC 4997, known as a high-density object. The values $T = 19{,}500°$ and $n_e = 8.3 \times 10^5\ \text{cm}^{-3}$ were obtained. (auth)

43703 SPECTRUM OF RW AUR IN THE REGION λλ3600-4800. Mirzoyan, L. V.; Kazaryan, E. S. Astrophysics (Engl. Transl.), 1: 122-5(Apr.-June 1965).
Translated from Astrofizika, 1: 213-23(1965).

The energy distribution in the continuous spectrum of RW Aur was investigated. This distribution varies appreciably as a function of star brightness. The contribution of short-wave continuous emission becomes important with attenuation of brightness. At the same time, the shortwave color index becomes bluer. The beginning of continuous emission slides along the spectrum, moving in the direction of long waves with an enhancement of relative intensity. The intensity of the continuous spectrum and the equivalent widths of the H and K emission lines of ionized calcium have an inverse correlation. (auth)

43704 DISTRIBUTION OF SCULPTOR-TYPE DWARF SYSTEMS IN THE VIRGO CLUSTER OF GALAXIES. Karachentsev, I. D. Astrophysics (Engl. Transl.), 1: 118-21(Apr.-June 1965).
Translated from Astrofizika, 1: 203-11(1965).

The distribution of Sculptor-like dwarf galaxies in the Virgo cluster was studied using the maps of the Palomar Sky Survey. A total of 165 dwarf systems was found in an area of 432 square degrees. A physical relationship was discovered between dwarf systems and individual bright galaxies; the relationship is closer for the brightest galaxies. Expressions for the hypergeometric probability distribution reveal a stronger statistical relationship between systems of the Sculptor type and elliptical galaxies than between the former and spirals. No tendency toward formation of isolated groups in dwarf systems was discovered. (auth)

43705 NEUTRINO ABSORPTION AT SUPERHIGH TEMPERATURES. Vartanyan, Yu. L. (Central Scientific Research Physical-Technical Lab., Erevan). Astrophysics (Engl. Transl.), 1: 108-11(Apr.-June 1965).
Translated from Astrofizika, 1: 183-92(1965).

The absorption of neutrinos in celestial bodies is considered. The absorption coefficient, the expression for which is averaged over the neutrino spectrum, is computed. It is demonstrated that at temperatures $T \geq 10^{9}$°K the neutrino absorption coefficient depends on temperature as T^5, that is, intense absorption of neutrinos occurs. (auth)

43706 INFLUENCE OF COLLISIONS OF ATOMS WITH ELECTRONS ON THE INTENSITY OF BALMER LINES IN THE SPECTRA OF MOVING ENVELOPES OF STARS. Gorbatskii, V. G. (Leningrad State Univ.). Astrophysics (Engl. Transl.), 1: 80-4(Apr.-June 1965).
Translated from Astrofizika, 1: 129-42(1965).

The relative intensities of the emission lines of the Balmer series in the spectrum of a moving envelope, opaque in the lines, is computed. Excitation and ionization of atoms by electron collision are taken into account. A hydrogen atom with ten discrete levels is considered. In the case of a high electron concentration ($10^{9} \lesssim n_e \lesssim 10^{13}$ cm^{-3}) the Balmer decrement is very gently sloping in comparison with the decrement computed for a medium transparent in the lines. The result is used to account for the observed intensities of the Balmer lines in the spectra of long-period variables and former novae. (auth)

43707 A SPECIAL CASE OF EQUILIBRIUM OF A ROTATING CYLINDRICAL CONFIGURATION IN THE PRESENCE OF A MAGNETIC FIELD. Oganesyan, R. S. (Erevan State Univ.). Astrophysics (Engl. Transl.), 1: 112-13(Apr.-June 1965).
Translated from Astrofizika, 1: 193-6(1965).

The problem of the equilibrium state of a self-gravitating cylindrical field is considered, with rotation taken into account, in the presence of a magnetic field, assuming mutual compensation of centrifugal and magnetic forces. The strength of the magnetic field is computed for solid-body ($\omega = \omega_0 = \text{const}$) and non-solid-body $\omega = \omega_0/(1 + \alpha^2 r^2)$ rotation. (auth)

43708 RADIO EMISSION OF THE GALACTIC NUCLEUS. Malumyan, V. G. Astrophysics (Engl. Transl.), 1: 184(July-Sept. 1965).
Translated from Astrofizika, 1: 347-9(1965).

An explanation is offered for the strong decrease in the radio emission flux of the galactic center at meter wavelengths which does not require the presence of ionized hydrogen, localized in the region of the nucleus itself, or a special form of its radio emission spectrum. (W.D.M.)

43709 SPECTROSCOPIC STUDY OF v 603 Aql (NAql 1918). Mustel, E. R.; Boyarchuk, A. A. (Crimean Astrophysical Observatory, Ashkhabad, USSR). Astrophysics (Engl. Transl.), 1: 178-82(July-Sept. 1965).
Translated from Astrofizika, 1: 337-46(1965).

The "former" nova v 603 Aql was studied using slit and slitless spectrograms. It was found that the star has a temperature of 30,000°K and a radius of 3×10^{10} cm. It is surrounded by an envelope of dimensions $R_{env} = 5R_{star}$ and has a mass $M_{env} \approx 10^{22}$ g. The electron density in the envelope in $n_e \simeq 10^{13}$ cm^{-3}. Motions of gases at a velocity ~300 km/sec occur in the envelope. (auth)

43710 NONSTATIONARY STELLAR ENVELOPES CONTAINING HIGH-ENERGY ELECTRONS. Gurzadyan, G. A. Astrophysics (Engl. Transl.), 1: 170-6(July-Sept. 1965).
Translated from Astrofizika, 1: 313-35(1965).

The following problem is considered: nonthermal, but not extremely relativistic electrons with a kinetic energy exceeding the characteristic energy, that is $E > mc^2$, appear in the atmosphere of some star, directly above the photosphere. The scattering of photons at such electrons is accompanied by an increase in the frequency of the photon scattered after collision (inverse Compton effect). The spectrum of the radiation emanating from the said electron layer or cloud found on the assumption that the Planck spectrum of the photosphere is known. The formulated problem is solved in the first approximation for cases of monochromatic and nonmonochromatic electrons. It is shown that the effect of scattering of photospheric radiation at fast electrons leads to an intensification of the shortwave part of the spectrum and attenuation in the infrared. The theoretical color indices and the amplitudes of brightness variations during a flare, that is, during the appearance of fast electrons above the photosphere, are determined. The effects of brightness increase and increased blueness are expressed most clearly in cold dwarfs and decrease rapidly with transition to stars of early classes. The possibility of the release of γ radiation during a flare and the inevitable heating of the photosphere of flare stars under the influence of their own γ radiation, rather than from within, are noted. (auth)

43711 STATISTICAL PARAMETERS OF THE RADIATION OF IRREGULAR AND SEMIREGULAR VARIABLES. Lukatskaya, F. I.; Zel'tsman, A. P. (Main Astronomical Observatory, Kiev). Astrophysics (Engl. Transl.), 1: 166-8(July-Sept. 1965).
Translated from Astrofizika, 1: 313-18(1965).

This paper is a development of work by L. Gratton, who has investigated the Ambartsumyan model for rapid irregular variables. An integral expression for the distribution of flare amplitudes, based on the observed brightness distributions of the investigated stars, is derived for the case of exponential increase and decrease of the flares. The amplitude distribution in explicit form using a gamma distribution for the flare radiation intensity. The flare stars PZ Mon and AE Aqr are considered as examples. Some corollaries of the derived relations are discussed. (auth)

43712 THE NONSTATIONARY CHARACTER OF THE VIRGO CLUSTER OF GALAXIES. Karachentsev, I. D. Astrophysics (Engl. Transl.), 1: 160-4(July-Sept. 1965).
Translated from Astrofizika, 1: 303-12(1965).

The Vaucolers hypothesis concerning the existence of individual E and S clouds in the region of Virgo is critically examined. The presence of many pairs with mixed (E and S) components in the cluster is at variance with the concept of spatial separation of elliptical and spiral galaxies. Application of the virial theorem to the cluster gives a mass–luminosity ratio $f = 665\ M_{\odot}/L_{\odot}$. It is shown that allowing for faint galaxies has virtually no effect on f, despite an increase in the integral luminosity of the cluster. Data are presented on the segregation of galaxies according to brightness and type along the radius of the cluster. Application of the virial theorem gives $\bar{f} = 375 \pm 180$ for groups of galaxies in Virgo and $\bar{f} = 137 \pm 74$ for pairs. The influence of the possible presence of "latent" matter on the f for pairs, groups and cluster is analyzed. The conclusion is drawn that there is no form of "latent" matter which can satisfactorily explain the determined value of f. The hypothesis that the cluster and the subsystems entering into it are nonstationary and expanding and that new galaxies are forming within the cluster agrees best with the observational data as a whole. A decrease in the dispersion of the radial velocities of galaxies toward the boundary of the cluster was discovered; this is to be expected in the case of expansion. (auth)

43713 THEORY OF THE REFLECTION EFFECT IN CLOSE BINARY SYSTEMS. Minin, I. N. (Leningrad State Univ.). Astrophysics (Engl. Transl.), 1: 148-51(July-Sept. 1965).
Translated from Astrofizika, 1: 275-84(1965).

The scattering of light in a one-dimensional semi-infinite medium with isotropic scattering is considered. It is assumed that the medium is illuminated by external radiation whose intensity varies periodically with time. An exact solution is obtained by the Laplace transform method. The results are applied to the study of the reflection effect in close binary systems. (auth)

43714 OSCILLATIONS OF A SINGULAR SPHERE. Lupanov, G. A. (Gorky Scientific Research Radiophysical Inst., USSR). Astrophysics (Engl. Transl.), 1: 144-6(July-Sept. 1965).
Translated from Astrofizika, 1: 267-74(1965).

The equations of pulsations of spherically symmetrical configurations in the general theory of relativity were derived more simply than by Chandrasekhar. As an illustration, the case of a singular ($\epsilon \sim 1/r^2$) sphere was considered and its oscillation frequencies and instability conditions were determined. (auth)

43715 MODEL OF A UNIVERSE WITH A UNIFORM MAGNETIC FIELD. Doroshkevich, A. G. (Steklov Mathematics Inst., Ashkhabad, USSR). Astrophysics (Engl. Transl.), 1: 138-42(July-Sept. 1965).
Translated from Astrofizika, 1: 255-66(1965).

A number of exact solutions for anisotropic uniform models of a universe with and without a magnetic field were considered. The behavior of the solutions near the singular point and at late stages of expansion was investigated. Particular attention was paid to the influence of a magnetic field on the properties of the solutions. (auth)

43716 TWO EXTREMELY BLUE OBJECTS NEAR A D GALAXY. Saakyan, K. A. Astrophysics (Engl. Transl.), 1: 78-9(Jan.-Mar. 1965).
Translated from Astrofizika, 1: 126-7(1965).

Two extremely blue objects were discovered near the galaxy ($\alpha = 17^h24.4^m$, $\delta = +41°38'$). The galaxy has a magnitude of about 15.5^m and a nucleus of elliptical configuration, and is surrounded by an extended envelope. The stellar magnitudes of both blue objects (18.2^m) were estimated on a single Agfa special plate without a filter and on two plates with a UG_2 filter that made it possible to estimate the U values. One photograph in the V system was used. (W.D.M.)

43717 ON TWO BLUE GALAXIES. Saakyan, K. A.; Mnatsakanyan, R. G. Astrophysics (Engl. Transl.), 1: 78(Jan.-Mar. 1965).
Translated from Astrofizika, 1: 125-6(1965).

In the course of an investigation of blue stars near the spherical cluster M92, several interesting blue objects were noted. Data on two blue galaxies are presented. (W.D.M.)

43718 CONTINUOUS FORMATION AND RATES OF DEVELOPMENT OF STARS IN STELLAR ASSOCIATIONS. Mirzoyan, L. V. (Academy of Sciences, Erevan). Astrophysics (Engl. Transl.), 1: 70-7(Jan.-Mar. 1965).
Translated from Astrofizika, 1: 109-24(1965).

Observational data on the distribution of O–B1 stars around the nuclei of stellar associations were analyzed. The influence of an existing radial gradient of the expansion rate on the law of distribution of star density in associations was evaluated. The ageing of O–B1 stars with increasing distance from the nuclei and with time was studied and the period of half-ageing of O–B1 stars, defined as the time interval necessary for the ageing of half of all the stars of the classes in question, was estimated. These estimates fall in the range 5×10^6 to 2×10^7 years. (W.D.M.)

43719 ELECTRON TEMPERATURE GRADIENT IN PLANETARY NEBULAE. Gurzadyan, G. A. Astrophysics (Engl. Transl.), 1: 61-9(Jan.-Mar. 1965).
Translated from Astrofizika, 1: 91-108(1965).

Planetary nebulae are not gaseous formations that are isothermal throughout. The electron temperature in their central regions may reach 30,000°. The increase in electron temperature in the direction of the center of the nebula can be attributed to attenuation of the effect of cooling by ions of different elements. The latter is associated with the increase in the excitation potential of the lowest metastable level for a particular ion with increase in the degree of ionization. The insignificant role played by inelastic collisions with hydrogen atoms in nebulae is pointed out. The possibility of determining electron temperatures in the central regions of planetary nebulae from observations is discussed. (auth)

43720 SPECTROPHOTOMETRIC INVESTIGATION OF THE NUCLEUS OF NGC 1068. Dibai, E. A.; Pronik, V. I. Astrophysics (Engl. Transl.), 1: 54-60(Jan.-Mar. 1965).
Translated from Astrofizika, 1: 78-90(1965).

The results of a spectrophotometric study of the nucleus of the Seyfert galaxy NGC 1068, whose emission spectrum has broad emission lines, are presented. The spectrograms were obtained using a spectrograph with a dispersion of 120 A/mm in the Cassegrainian focus of a 50" reflector. The intensities of the lines [O III] and [S II] were used in estimating the electron density (10^3 cm^{-3}) and electron temperature (17,000°). The effective volume of the luminescent gas is 2×10^{59} cm^3 ($r_s \approx 20$ parsecs) and the mass is $2 \times 10^5_{\odot}$. At a velocity of 1200 km/sec the gas possesses a kinetic energy of 3×10^{54} ergs, and its escape is apparently caused by some process of an explosive character which took place about 10^5 years ago. The luminescence time (3×10^2 years) is less than the "age" of the escaping gas, and therefore the luminescence of the latter (1.4×10^{42} ergs/sec) has a quasi-stationary character. The following excitation mechanisms are considered: gas ionization by hot stars, by synchrotron L_c quanta, by cosmic rays, by the "stellar wind," and finally, by shock waves. Energy considerations lead to the conclusion that the latter apparently is the most probable; however, even in this case certain difficulties are involved. In conclusion, the initial ejected mass ($0.4 \times 10^5 \leq M_0 \leq 2 \times 10^5_{\odot}$) and the initial energy of the explosion ($\approx 10^{55}$ ergs) are given as estimates. (auth)

43721 A DETAILED PHOTOMETRIC AND COLORIMETRIC STUDY OF GALAXIES IN THE CONSTELLATION VIRGO. Markaryan, B. E.; Oganesyan, E. Ya.; Arakelyan, S. N. Astrophysics (Engl. Transl.), 1: 23-53(Jan.-Mar. 1965).
Translated from Astrofizika, 1: 38-77(1965).

Results of a detailed photometric and colorimetric investigation of ten elliptical and lenticular galaxies are presented. The observations were made with a 40-inch Schmidt telescope in blue and yellow light. Charts of the brightness and color distributions for all the investigated galaxies are given. (W.D.M.)

43722 MASS DEFECT OF BARYON STARS. Ambartsumyan, V. A.; Saakyan, G. S. Astrophysics (Engl. Transl.), 1: 1-9(Jan.-Mar. 1965).
Translated from Astrofizika, 1: 7-21(1965).

The gravitational mass defect $\Delta M = nm_n - M$ of neutron configurations was investigated. Here M is the mass of the star, n is the number of neutrons it contains, and m_n is the neutron mass. It is shown that in the case of central densities $\rho(0)$ exceeding nuclear density by an order of magnitude ΔM exhibits anomalous behavior (according to Einstein's gravitational theory). The anomaly consists in that with increase in $\rho(0)$ the mass defect decreases and, in the case of central baryon densities exceeding 10^{40} cm^{-3}, becomes negative. This phenomenon is caused by the severe disruption of additivity of internal energy in an intense gravity field, where nonlinear effects are extremely important. In Newton's theory of gravitation ΔM is positive for all densities. Baryon stars with a negative mass defect have a colossal reserve of internal energy. This energy is of the order of the proper energy of the star itself. (auth)

43723 CHARGE TRANSFER INTERACTIONS BETWEEN SOLAR-WIND PROTONS AND NEUTRAL PARTICLES IN THE VICINITY OF THE SUN. Fahr, H. J. (Bonn Univ.). Nature (London), 219: 473-4(Aug. 3, 1968).

Interstellar matter has a good chance of reaching within a few au of the Sun before undergoing collisions with solar protons moving radially outwards from the Sun. On their way from the Sun to the Earth solar-wind protons generate fast neutral particles by charge transfer collisions with interstellar particles, and these fast neutral particles bombard the Earth's upper atmosphere and transport energy directly downward to the thermosphere. From considerations discussed it might be concluded that the energy provided by the flux of fast neutral atoms entering the upper atmosphere could contribute to observed semi-annual variations in thermospheric temperature and density. (UK)

43724 QUASARS AND QUARKS. Huang, J. C.; Edwards, T. W. (Univ. of Missouri, Columbia). Phys. Rev., 171: 1331-4 (July 25, 1968).

A reinterpretation of the spectrum of the quasar 3C 191 is accomplished on the basis of a model quasar containing both ordinary nuclear atoms and atoms whose nuclear charge has been reduced by $\frac{1}{3}$e or $\frac{2}{3}$e through loss of quarks. All observed spectral lines, including those not previously identified, are identified as arising from cosmically abundant elements in similar ionization states and with roughly correct intensity levels. A reduced red shift is found ($z = 0.31$) which lowers the required luminosity of 3C 191 to less than that of the brightest galaxies. The results also indicate a periodic structure: Lines corresponding to atomic levels for an element with one quark missing appear along with lines corresponding to the same atomic levels for the same element with two quarks missing. (auth).

43725 THE UNSETTLED SUN. Hindley, Keith (Univ. of Liverpool). New Sci., 39: 228-31(Aug. 1, 1968).

Intense activity on the Sun's surface has recently drenched the Earth and its surroundings with bursts of x rays, protons, and radio waves, producing widespread changes in the atmosphere, disruption of radio communications, and severe magnetic storms.

As solar maximum approaches, these outbursts will occur with greater frequency. (auth) (UK)

43726 NUCLEI OF BARRED GALAXIES. Tovmasyan, G. M. Astrophysics (Engl. Transl.), 1: 114-16(Apr.-June 1965). Translated from Astrofizika, 1: 197-202(1965).

Results of observations of the nuclei of 20 barred galaxies on the 21″ Schmidt telescope of the Byurakan Observatory are presented. These results supplement the general information on barred galaxies given previously. Distribution curves for the nuclei of all 70 barred galaxies studied are given on a 5-point scale. In the case of starlike nuclei, the observed dependence of the absolute magnitude on the absolute magnitude of the galaxy as a whole is apparently real. (auth)

43727 NEW MORPHOLOGICAL TYPES OF GALAXIES. Vorontsov-Velyaminov, B. (Sternberg Astronomical Inst., Moscow). pp 347-60 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967.

From the study of structure of some 10,000 galaxies (ellipticals excluded) reproduced from the Palomar Sky Atlas it is argued that the existing classifications are not adequate to the enormous variety of structures. The "peculiar" galaxies are also too numerous to be left out of scope of the classification. Rings and discs are often the most prominent features of structure. They have different degrees of resolution and deserve to be isolated in separate sequences. Some new morphological types of galaxies are reproduced together with the additional illustrations of the forms which cannot be explained by purely mechanical processes. (auth)

43728 DWARF GALAXIES IN CLUSTERS. Reaves, Gibson (Univ. of Southern California, Los Angeles). pp 337-45 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967.

Because studies of the various kinds of stars that compose galactic clusters have provided a great deal of knowledge about stellar evolution, it may be expected, by analogy, that studies of the population of clusters of galaxies will provide insights into the origin and evolution of galaxies. With this in mind the dwarf galaxy populations of some clusters of galaxies are considered, specifically, the Local group, the Virgo cluster, the Canes Venatici cluster, and the Fornax cluster. (W.D.M.)

43729 ACICULAR GALAXIES. Ogorodnikov, K. F. (Leningrad Univ.). pp 329-36 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967.

The properties of the acicular (elongated ellipsoids) galaxies are considered and a few cosmological conjectures are made. (W.D.M.)

43730 PROBLEMS RELATED TO THE RECTIFICATION OF SPIRAL GALAXIES. Pismis, Paris (Univ. Nacional de Mexico, Mexico City). pp 319-28 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967.

In discussing observational data related to flattened galaxies (spirals) it is useful to know the orientation of their plane of symmetry with respect to the observer. Only by the help of this piece of information is it possible to arrive at a more objective representation of the structural and kinematical features of the galaxy. It becomes, thus, necessary to reconstruct the face-on view of it, in other words "to rectify" the galaxy. This problem of orientation cannot be solved generally; therefore, simplifying assumptions have to be made. The procedures, or methods, employed to rectify a galazy fall broadly into two categories which may be termed structural and kinematical, respectively. Here it is proposed to examine each of these methods in some detail and discuss their implications. A basic assumption to start with, in both procedures, is that spiral features are coplanar. (W.D.M.)

43731 STRUCTURE OF GALAXIES AND FORMATION OF SPIRAL ARMS. Pikelner, S. B. (Sternberg Astronomical Inst., Moscow). pp 307-18 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967.

The structure of galaxies and formation of spiral arms by magnetic tubes are briefly reveiwed. The special case of barred spirals is considered. (W.D.M.)

43732 MACHINE COMPUTATION OF SPECTROSCOPIC BINARY ELEMENTS. Wolfe, R. H. Jr.; Horak, Henry G.; Storer, N. Wyman (Univ. of Kansas, Lawrence). pp 251-73 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967.

A Fortran II program is given for calculating the elements of a spectroscopic binary orbit. The method is that of Wilsing–Russell followed by a differential correlation, but modified to apply to high as well as low eccentricities. A preliminary value for the period is required, which can, if desired, be improved by the differential correction. (auth)

43733 MASSES OF NINE VISUAL BINARY SYSTEMS. Wilson, O. C. (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). pp 241-9 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967.

To determine the absolute magnitudes, spectroscopic observations at a dispersion of 10 Å/mm were made at Mount Wilson and Palomar. A sufficient number of spectrograms, about 10, was obtained for each object in order to reduce the internal probable error of M_v to approximately 0.1 mag. (W.D.M.)

43734 STELLAR MULTIPLICITY: AN ASPECT OF THE OBSERVATIONAL APPROACH TO STELLAR EVOLUTION. Hynek, J. A. (Northwestern Univ., Evanston, Ill.). pp 225-40 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967.

One avenue of marked sensitivity and power for observational confirmation of the present theory of stellar evolution is offered by a comparison of the frequency of binary systems among giant and dwarf sequences, of the Δm's of the visual binaries in these respective sequences, and of the linear separation of the components of giant and dwarf visual binaries. An attempt is made to determine whether the numbers, kinds, and motions of giant and dwarf binary systems support modern theories of stellar evolution. A computer approach to this problem is described. (W.D.M.)

43735 SPECTROSCOPIC BINARY HD 698. Sahade, Jorge (Observatorio Astromomico, La Plata). pp 219-24 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967.

High dispersion spectrograms of HD 698 definitely confirm that the lines of the secondary component are not present in the spectrum, one is probably dealing here with another system where the mass of the fainter component is larger than that of the primary. The period of the orbital motion was corrected to 55.927 days. The system is no longer a case for the existence of very large stellar masses. (auth)

43736 EFFECT OF NONSYNCHRONOUS ROTATION ON CLOSE BINARY STARS. Huang, Su-shu (Catholic Univ. of America, Washington, D. C. Goddard Space Flight Center, Greenbelt, Md.). pp 211-18 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967.

The effect of nonsynchronous rotation of the component star in close binaries on its limiting surface is analyzed and the difficulties in previous investigations are examined. It has been shown that no potential function exists in a coordinate system following the axial (nonsynchronous) rotation of the component star. Consequently, no equilibrium surfaces can be obtained in this way. It is therefore suggested that one should retain the conventional coordinate system that rotates with the binary motion. Since a simple energy integral exists in this coordinate system, a physical picture can be obtained for the problem of the nonsynchronously rotating star in the binary systems. Indeed it is found that the nonsynchronously rotating star will modify its rotation gradually and become eventually synchronous with its orbital revolution. (auth)

43737 CENTRE-LIMB VARIATION OF LINE PROFILE IN A MOVING ATMOSPHERE. Abhyankar, K. D. (Osmania Univ., Hyderabad, India). pp 199-210 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967.

From the radiation field in a moving atmosphere, obtained earlier (Abhyankar, 1964 b) for a Gaussian scattering function and a linear velocity law, line profiles were computed for various angles of emergence. An optical thickness of $10/\sqrt{3}$ for the reversing layer and a maximum outward velocity of $10\sqrt{3}/\Delta\nu$ at the top of the atmosphere, where $\Delta\nu$ is the Gaussian parameter of the scattering function, were assumed. Line profiles at various points of the disc are shown for isotropic scattering and for a phase function with scattering in forward and backward directions only. The integrated line profiles for a uniform disc with no limb darkening ($X = 0$) and for a disc with complete darkening at the limb ($X = 1$) are shown. These results support Struve's hypothesis of a network of prominences in supergiant stars. (auth)

43738 HELIUM-HYDROGEN RATIO FOR POPULATION I STARS DEDUCED FROM BINARY DATA. Stroemgren, Bengt (Inst. for Advanced Study, Princeton, N. J.). pp 185-9 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967.

In a recent investigation Kelsall and Strömgren (1965) calculated evolutionary model sequences for main-sequence B and A stars for six different assumptions regarding the initial chemical composition. In the present investigation these results were utilized for a determination of the initial He/H ratio for a number of main-sequence B and A stars with well-determined masses radii, and luminosities. The stars in question consist of components of eclipsing binary systems and one visual binary component, Sirius A. (W.D.M.)

43739 HYDROGEN-POOR STARS. **Hack, Margherita (Astronomical Observatory, Trieste, Italy). pp 163-83 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967.**

Only a few stars are known which are hydrogen-deficient, ϵ Sag and R Coronae Borealis being the best known representatives of the group. The properties of all these stars were reviewed in an attempt to understand the reasons for their hydrogen depletion, and for the other abundance peculiarities. (W.D.M.)

43740 STARS OF LOW LUMINOSITY. **Luyten, Willem J. (Univ. of Minnesota, Minneapolis). pp 149-54 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967.**

One of the principal aims of the proper motion survey on 48″ Schmidt plates was to determine the frequency and the kinematic properties of the stars of low luminosity and, from it, to make a new determination of the luminosity function. While the survey has been operating only two years, enough material has accumulated to make possible at least a preliminary analysis, especially for the stars of very low luminosity, almost unknown before. (W.D.M.)

43741 ABUNDANCES OF THE RARE EARTHS IN SIX F STARS. **Wallerstein, George (Univ. of California, San Diego). pp 155-62 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967.**

The abundances of such rare earths as appear in the spectra of six F stars were derived. The stars were chosen because extensive tables of their equivalent widths have been published. In addition, they represent a considerable range in overall metal content. (W.D.M.)

43742 LUMINOSITIES OF THE BETA CEPHEI VARIABLE STARS. **McNamara, D. H.; Matthews, G. E. (Brigham Young Univ., Provo, Utah). pp 127-36 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967.**

Luminosities of the β Cephei stars were determined from measurements of the β index and equivalent widths of the Hγ and Hδ lines of hydrogen. The period-color, and period-luminosity relations were derived from all existing data, and the position of the β Cephei variables in the H-R diagram was compared with the "zero-age" main sequence. (auth)

43743 PECULIAR A STARS AND THE OBLIQUE ROTATOR HYPOTHESIS. **Boehm-Vitense, Erika (Institut fuer Theoretische Physik, Kiel). pp 97-126 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967.**

After a brief review of the observations on the Ap stars the oblique rotator hypothesis is discussed in detail. A magnetic field (called H 3) is found which does reproduce the observed mean periodic variations of the magnetic α variables. The inclination between the axis of rotation and the magnetic axis is about 70°. The properties of the field H 3 are discussed. Connections with solar activity are shown. The spectroscopic variations are connected with the magnetic observations. It is found that the Eu II lines are mainly formed in both polar regions while the Cr II lines originate in an equatorial belt. The Ap stars appear to be more slowly rotating than normal A stars. The relatively slow rotation and the absence of an effective hydrogen convection zone in the A stars are used as an argument in favor of the fossil hypothesis for the magnetic fields. (auth)

43744 PHOTOMETRIC CRITERION OF THE STELLAR POPULATION FROM PHOTOMETRY IN SIX COLORS OF THE LICK OBSERVATORY. **Canavaggia, R. (Observatoire de Paris). pp 85-96 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967. (In French).**

An infrared photometric criterion of the stellar population, drawn from four colors in addition to reds from six-color photometry at the Lick Observatory, is compared with the m_1 criterion from the UVBY photometry of Strömgren for 23 stars of the principal sequence of F8V to G2V. (tr-auth)

43745 NOTE ON THE MK CLASSIFICATION SYSTEM. **Morgan, W. W. (Univ. of Chicago). pp 83-4 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967.**

It would appear that the MK spectral type and luminosity class are not by themselves completely satisfactory for the precise classification of what have been considered "normal" stellar spectra; the problem is to devise a modification which would be more satisfactory. For this purpose, a supplementary hierarchy is introduced, which is labeled "coeval sequences." A coeval sequence is a series of spectra of stars belonging to a single cluster, or of a group of stars possessing similar ages. (W.D.M.)

43746 SURFACE BRIGHTNESS OF DARK NEBULAE. **Lynds, Beverly T. (Univ. of Arizona, Tucson). pp 67-81 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967.**

The analysis in this paper follows the method adopted by Struve. Only single scatterings in a semi-infinite plane parallel atmosphere are included, thus the equation $I = \gamma \varphi (\alpha) I_0 \cos i/\cos i + \cos e$ is used (γ is albedo of scattering particles; I_0 is specific intensity of incident radiation; i and e are incident and scattering angles, respectively; and $\varphi(\alpha)$ the net phase function, α being i + e). Subsequent to Struve and Henyey's pioneering work, an exact solution to the transfer of radiation scattered by a plane parallel atmosphere was given by Chandrosekhar and Breen (1948), using a phase function of the form of $\gamma(1 + A \cos \alpha)$. Tabulated values of the emergent intensity are presented for various albedos and values of the parameter A. (W.D.M.)

43747 DIFFUSE GALACTIC LIGHT. **Roach, F. E. (Inst. for Telecommunication Sciences and Aeronomy, Boulder, Colo.). pp 49-66 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967.**

An examination of the original paper by Roach and Smith (NBS Technical Note 214) shows that their estimate of the galactic light is based on the empirical observation that the quantity (S + G)/S in the region well away from the Milky Way was found to be 1.26. Applying this factor to the average values of S in the vicinity of the Milky Way results in galactic light estimates for latitude $0°S_{10}$ (pg) units. The basic data contained in the paper by Roach and Smith were reexamined in the region of low galactic latitudes and are presented. (W.D.M.)

43748 SOLAR ACTIVITY AND EFFLUX OF GASES FROM THE SUN. **Mustel, E. R. (Astronomical Council, Moscow). pp 31-42 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967.**

Particles which leave the Sun are divided into two groups. To the first group belong particles (ions, electrons, neutral atoms) the kinetic energy of translational motion of which is relatively low (a few hundred km/sec up to 2 to 3×10^3 km/sec). To the second group belong particles of solar origin (ions and electrons), which are characterized by considerably higher energy and which are called solar cosmic rays. In this paper particles of the first group are considered and their interaction with the solar wind is discussed. (W.D.M.)

43749 KEPLER'S THIRD LAW AND RADAR DETERMINATIONS OF THE ASTRONOMICAL UNIT OF LENGTH IN GENERAL RELATIVITY. **Rudkjoebing, Mogens (Ole Roemer Observatory, Aarhus, Denmark). pp 17-29 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967.**

Kepler's third law for planetary motion is found to be valid without relativistic corrections when the semi-major axis is measured by the value of the coordinate r of Schwarzschild's solution for the line element in a weak-field approximation, for orbits of small eccentricity. This result permits the calculation of relativistic corrections to the value of the astronomical unit of length as calculated according to classical formalism from radio-echo observations of distances between the Earth and Venus. (auth)

43750 MODERN ASTROPHYSICS. **A Memorial to Otto Struve. Hack, M. New York, Gordon and Breach, 1967. 360p. $19.50.**

Separate abstracts were prepared for 25 of the 29 papers. (W.D.M.)

For abstracts of individual papers see: 43727–43749, 43947, and 44288.

43751 RECOMBINATION OF HYDROGEN IN THE HOT MODEL OF THE UNIVERSE. **Zel'dovich, Ya. B.; Kurt, V. G.; Syunyaev, R. A. (Inst. of Applied Mathematics, Moscow). Zh. Eksp. Teor. Fiz., 55: 278-86(July 1968). (In Russian).**

The considerable emission of energetic quanta during recombination of hydrogen in the expanding Universe results in a slowing down of recombination and to distortion of the relict radiation spectrum in the Wien region. Energy exchange between the electrons and radiation in the Compton effect maintains the temperature of matter equal to that of the radiation temperature up to a time which corresponds to a red shift $z \sim 150$; one consequence of this is a change in the time dependence of the Jeans wavelength of gravitational instability of a homogeneous medium in the expanding universe. (auth)

43752 SINGULARITY-FREE EMPTY UNIVERSE.. **Mizner, Ch. V.; Taub, A. Kh. (Cambridge Univ., Eng. Univ. of California, Berkeley). Zh. Eksp. Teor. Fiz., 55: 233-55(July 1968). (In Russian).**

A solution of the empty space Einstein equations $R_{\mu\nu} = 0$ is studied. It is a cosmological model, M, in the sense that it incorporates a metric which has closed homogeneous space-like hypersurfaces which expand anisotropically. It is everywhere analytic (C^ω) with Lorentz (+ + + –) signature and is shown to be nonsingular in the sense of "distant boundaries" in that every geodesic arc which approaches the boundaries (i.e., which cannot be contained in any compact set) has infinite affine length. However, it also incorporates the Newman, Unti, and Tamburino metric (NUT metric) which contains closed time-like and null lines. The analytic continuation from M to NUT space can be done in (at least) two inequivalent ways. The physical evolution of M toward NUT space in unstable and short wavelength perturbations (gravitons, photons, etc.) is accelerated to disruptive energies before the Cauchy horizon separating the cosmological and the NUT regions is attained. This instability is shown by the same behavior of time-like and null geodesics which shows that this space-time is not geodesically complete, and that no analytic continuation of M can be. This space-time is also considered here in connection with the topic of the prevalence and nature of singularities in general cosmological solutions of the Einstein equations. (auth)

43753 MEASUREMENT OF THE ABUNDANCE OF ^{32}P AND ^{33}P IN THE SAINT-SEVERIN METEORITE. Tobailem, Jacques; Yokoyama, Yuji; Mabuchi, Hisao; Baillard, Noelle (Centre d'Etudes Nucleaires, Saclay, France. CNRS, Gif-sur-Yvette, France. Tokyo Univ.). Compt. Rend., Ser. A and B, 266: 1636-9(June 24, 1968). (In French).

Phosphorus-32 and phosphorus-33 were determined in the Saint-Séverin meteorite. The activities, at the time of the fall, are ^{32}P: 25.0 ± 1.4 dpm kg^{-1}, ^{33}P: ≤1.7 dpm kg^{-1}. Contributions of the different modes of production were evaluated for the two nuclides. From the results obtained for phosphorus-32 the flux of fast and slow neutrons of solar origin was calculated. (tr-auth)

43754 INFRARED SKY. Neugebauer, G.; Leighton, Robert B. Sci. Amer., 219: No. 2, 51-60; 65(Aug. 1968).

A telescope with a 62-inch epoxy mirror has provided the first comprehensive survey of the night sky at infrared wavelengths. It has revealed some of the coolest celestial objects yet detected. The construction and operation of the telescope are summarized. Some of the principal results from the survey and their implications for galactic structure are discussed. (W.D.M.)

43755 INTERPRETATION OF THE DIFFERENTIAL CENTER-LIMB DARKENING OF DOUBLE STARS IN ECLIPSE. Van't Veer, Frans (Institut d'Astrophysique, Paris). Compt. Rend., Ser. A and B, 266: 1245-8(Apr. 29, 1968). (In French).

The data that can be drawn from the differential center-limb darkening are studied. These data can often be determined with good precision from multicolor observations of some binaries in eclipse. (tr-auth)

43756 MODEL FOR ASTRONOMICAL PULSED RADIO SOURCES. Henry, G. Reading (Stanford Univ., Calif.). Phys. Rev. Lett., 21: 468-9(Aug. 12, 1968).

A very simple model is suggested for the recently reported pulsed radio sources based on the vibrational (rather than compressional) modes of a star. (auth)

43757 GALACTIC DISTRIBUTION OF SPECTROSCOPIC BINARIES. Pedoussaut, Andre (Observatoire de Toulouse). Compt. Rend., Ser. A and B, 266: 1341-4(May 13, 1968). (In French).

The study of the distribution in galactic longitude of 764 spectroscopic binaries established a very sharp lack of observation in the southern hemisphere as well as a zone of deficiency toward l^{II} = 140°. This particular galactic region is thus once more evident. The comparison of these results to those obtained by others for visual binaries confirms these conclusions. (tr-auth)

43758 CENTER–LIMB DARKENING OF RZ CASSIOPEIAE. Ricard-Roux, Michele; Van't Veer, Frans (Institut d'Astrophysique, Paris). Compt. Rend., Ser. A and B, 266: 1345-8 (May 13, 1968). (In French).

Multicolored measurements of the luminosity of the system RZ Cas during the primary eclipse made it possible to study the derivative of the darkening coefficient with respect to the wavelength. (tr-auth)

43759 THE KLEIN–GORDON EQUATION IN GENERAL RELATIVITY. GENERAL RESOLUTION IN THE CASE OF PLANE GRAVITATIONAL WAVES WITHOUT POLARIZATION. Dolphin, Bernard; Schmitt, Pierre (Institut National des Sciences Appliquees, Villeurbanne, France). Compt. Rend., Ser. A and B, 266: 1086-8(May 13, 1968). (In French).

A Riemann variety having plane symmetry was considered. The Klein–Gordon equation was resolved for a scalar field $\phi(x,t)$. The results acquired were applied to the case of a plane gravitational wave without polarization. All the calculations used a cosmological term λ assumed not 0. (tr-auth)

43760 INVESTIGATION OF THE STABILITY OF AN ISOTROPIC UNIVERSE WITH A COSMOLOGICAL CONSTANT. Byalko, A. V. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz., 55: 317-22(July 1968). (In Russian).

The stability of an isotropic world with a cosmological constant Λ is considered. The nature of the variation of rotational perturbations and gravitational and sound waves with growth of the curvature is similar to the case with $\Lambda = 0$; in other words, stability exists in an expanding universe. With respect to density perturbations and the metric perturbations connected with it, it is found that they strongly grow near the critical curvature when Λ is close to the critical value Λ_c. (auth)

43761 ASYMPTOTIC BEHAVIOR OF LINEAR OSCILLATIONS OF A COMPRESSIBLE HOMOGENEOUS MODEL. Iweins, P. (Univ., Liege); Smeyers, P. Bull. Cl. Sci., Acad. Roy. Belg., 54: 164-76(Feb. 1968). (In French).

Asymptotic expressions are given for the eigenvalues and for the eigenfunctions $\alpha = \operatorname{div} \delta\vec{r}$ associated to the p-modes and to the g-modes of the homogeneous compressible sphere. The first approximation of Langer's asymptotic method gives good agreement with the exact eigenvalues. (auth)

43762 GRAVITATIONAL COLLAPSE OF NEUTRON STARS. Capra, F. (Univ. of Vienna). Acta Phys. Austr., 26: 327-38 (1967).

Gravitational collapse of neutron stars was studied by means of a model accounting for interactions between neutrons, vector mesons, and gravitons. It was found that for neutron stars of nuclear density there exists a critical radius $R_c \sim 10^7$ cm above which the gravitational collapse of the star cannot be stopped by nuclear forces. (auth)

43763 COSMIC PARTICLE CREATION PROCESSES. Sexl, Roman U.; Urbantke, Helmuth (Univ. of Vienna). Acta Phys. Austr., 26: 339-56(1967).

Quantum field theory is shown to be essential for any calculation of cosmic particle creation processes. Classical calculations are misleading. There are several possibilities to explain continuous creation which are all based on fields with negative energy that make the vacuum instable. A value of the light deflection larger than the Einstein value is an indication that such fields exist. A creation rate differing for particles and antiparticles is possible only in nonlocal field theories. Such a theory would predict a decay of the anti-proton with a lifetime of about $10^{5\pm3}$ years. Since frequencies of cosmic phenomena are generally very low there cannot be any connection between particle creation and cosmic expansion at present. Particle creation by the action of the gravitational field is possible in general relativity but was of importance only during the first 10^{-23} sec of the life of the Universe (assuming a closed Universe originating in a Big Bang). An estimate of this effect in the external field approximation leads to a possible explanation of one of the "Dirac laws" i.e., that the number N of particles in the Universe is equal to the square of the age of the Universe, $N = T^2$. The calculation supports the idea that $N = T_0^2$ where T_0 is the total lifetime of the closed Universe. (auth)

43764 DYADIC ANALYSIS OF SPATIALLY HOMOGENEOUS WORLD MODELS. Estabrook, F. B.; Wahlquist, H. D.; Behr, C. G. (California Inst. of Tech., Pasadena). J. Math. Phys. (N. Y.), 9: 497-504(Apr. 1968).

The dyadic formalism is applied to cosmological models, and leads to a convenient set of first-order ordinary differential equations. The Bianchi–Behr type of any model is shown to be constant in time, regardless of the state of the matter content. The case of perfect fluid matter content is formulated. Type-V models and Type VIII and IX models with incoherent matter are discussed, and some consistent subtypes delineated. The Gödel Hamiltonian for symmetric Type IX models is derived and generalized. (auth)

43765 EFFECTS ASSOCIATED WITH THE SECTOR BOUNDARY CROSSING ON JULY 8, 1966. Svestka, Z. (Astronomical Inst., Ondrejov, Czech.). Solar Phys., 4: 361-72(July 1968).

Thirty hours after the proton flare of July 7, 1966, the earth and nearby satellites crossed a sector boundary of the interplanetary magnetic field. This occurred before the flare-associated shock wave arrived at the earth, so that the space was filled with energetic particles ejected from the flare. Satellite measurements have shown that in such a case <20-MeV protons are stored within the range of the sector boundary and, with decreasing energy, the particles tend to accumulate towards and behind the Eastern boundary limit; low-energy particles, such as <50-keV electrons, are stored exclusively behind this Eastern limit. The boundary crossing caused a short-lived geomagnetic disturbance, a PCA enhancement in lower latitudes, a two-phase ionospheric disturbance, and a transient cosmic-ray decrease on neutron monitors looking westward immediately after the sector boundary passed the earth. The storage of low-energy particles on the Eastern side of the boundary may indicate a preference of the transverse diffusion for the Westward direction in interplanetary space. (auth)

43766 HYPOTHESIS CONCERNING QUARK STARS. **Ivanenko, D. D.; Kurdgelaidze, D. F. (Moscow State Univ.). Astrophysics (Engl. Transl.), 1: 251-2(Oct.-Dec. 1965).**

Translated from Astrofizika, 1: 479-82(1965).

With further compression of a star after the formation of a degenerate electron gas there is an "imbedding" of electrons into protons, a breakdown of the nuclei and a transition to a neutron star; with still further compression a transition to a degenerate hyperon Fermi gas follows. It is natural to assume that a transition to a still heavier baryon resonance may also be favored, and finally to the hypothetical sub-particles: quarks, etc. The conditions for the transition of a baryon star to a quark star are analyzed neglecting temperature. (W.D.M.)

43767 SODIUM VELOCITY FIELDS IN COMET 1965f. **Spinrad, Hyron (Univ. of California, Berkeley); Miner, Ellis D. Astrophys. J., 153: 355-66(Aug. 1968).**

The high-dispersion spectrograms of Comet 1965f (Ikeya–Seki) discussed in this paper were obtained on Oct. 20 and 21, 1965, (U.T.) with the McMath Solar Telescope at Kitt Peak National Observatory. The linear dispersion of the plates was almost exactly 5 mm Å^{-1} at the sodium D-lines. (W.D.M.)

43768 AN IDENTIFICATION OF THREE DIFFERENT VARIEITIES OF SOLAR FLARE. **McKenna-Lawlor, Susan M. P. (Univ. of Michigan, Ann Arbor). Astrophys. J., 153: 367-70 (Aug. 1968).**

Three different varieties of solar flare are identified and the terms "plage flares," "stationary prominence flares," and "one-arm" and "two-arm moving prominence flares" proposed to describe them. It is shown that successive brightenings within the same part of the chromospheric plage associated with an active region, individually defined as plage flares, may not always be called "homologous," since the relative positions, numbers, and field strengths of underlying spot umbrae can change radically with time. The more general term "resurgent plage flares" is used to describe such recurrent events. (auth)

43769 TURBULENCE, VISCOSITY, AND DISSIPATION IN THE SOLAR-WIND PLASMA. **Coleman, Paul J. Jr. (Univ. of California, Los Angeles). Astrophys. J., 153: 371-88(Aug. 1968).**

Estimates of the power spectra of the solar-wind magnetic field B and the radial component of the solar-wind plasma velocity V were computed for the frequency range from one cycle per solar rotation to 1.35×10^{-1} Hz. The measurements used in the calculations were obtained in 1962 with instruments on board the spacecraft Mariner 2. From the spectral properties of the plasma fluctuations, it is tentatively concluded that the solar-wind flow is often turbulent in the region near 1.0 au. A heuristic model of the turbulent flow that is consistent with the observations is one in which the energy for the turbulence is derived from the differential motion of the streams in the solar-wind plasma. Instabilities associated with the differential streaming produce long-wavelength Alfvén waves. The energy extracted from the differential motion cascades through a hierarchy of Alfvén waves until it reaches waves short enough for dissipation by proton cyclotron damping. As a result of this turbulent process the differential motion of the plasma streams is eliminated. During the Mariner 2 flight the mean variation in the streaming velocity over one period of solar rotation was 86 km sec^{-1}, so that the energy available in the plasma at 1.0 au due to this differential motion was about 3.8×10^{13} ergs gm^{-1}. The inertial-range spectrum of the turbulence evidently extended from about 10 cycles per day to somewhere above the magnetometer Nyquist frequency, 1.35×10^{-2} Hz. At these frequencies, the fluctuations in B were primarily transverse to the spiral-field direction. The fluctuations in the radial components of V and B exhibited equipartition of kinetic and magnetic energy, and the frequency dependences of both variables were roughly $f^{-1.2}$. The difference between the observed $f^{-1.2}$ dependence and the $f^{-1.5}$ dependence for such turbulence predicted by Kraichnan is tentatively attributed to fluctuations at the higher frequencies, described by Scarf, Wolfe, and Silva, that result from the operation of the garden-hose instability. Evidence for dissipation in the range $f > 0.2$ Hz, probably due to proton cyclotron damping, is cited. The power density in the inertial range indicates that the approximate mean rate of dissipation due to turbulence near 1.0 au was 2.4×10^{6} ergs gm^{-1} sec^{-1}. The lower limit for turbulent heating of the solar-wind protons between the Sun and 1.0 au is estimated to have been 3.6×10^{3}°K. The integral of the spectrum of the plasma fluctuations over the entire frequency range shows that energy remaining in the differential streaming and turbulence at 1.0 au was sufficient to heat the protons by another 8×10^{5}°K. (auth)

43770 ABSORPTION OF NON-THERMAL RADIO RADIATION IN THERMAL X-RAY SOURCES. **Allen, R. J. (Observatoire de Paris, Meudon, France). Astrophys. J., 153: 389-96(Aug. 1968).**

The following hypothesis, due to Sartori and Morrison, is taken as a point of departure: A thermal, x-ray-emitting plasma is a natural by-product of any known process which accelerates electrons to relativistic energies in cosmic radio sources. Several consequences of this hypothesis are developed from the observation that such a plasma will absorb the synchrotron radio radiation by the reverse of the process which produces the x rays. A simple theoretical model suggests that the non-thermal radio spectrum of such sources would exhibit a maximum and provides a relation among the frequency of this maximum and the x-ray flux density, temperature, and emission measure of the thermal plasma. Specific predictions are made for several known x-ray and radio sources. (auth)

43771 THE PECULIAR VARIABLE FG SAGITTAE. **Herbig, G. H.; Boyarchuk, A. A. (Lick Observatory, Santa Cruz, Calif.). Astrophys. J., 153: 397-420(Aug. 1968).**

The brightening of FG Sge from $m_{pg} = 13.6$ in 1894 to $B = 9.6$ in 1965 is examined in terms of the continuous outflow of matter from a hot, subluminous star. FG Sge is centered in an apparently normal planetary nebula of 18″ radius, but this envelope predates the present activity. Coudé spectrograms are available for the years 1960 to 1967, while information from low-dispersion plates begins in 1955. Over this period, the spectral type has changed progressively from B4 I to A5 Ia, the colors (1960 to 1965) have altered in the same sense, and strong P Cygni-like emission fringes at the Balmer lines have faded out. The high-luminosity spectrum is interpreted as being due to gas lying above a false photosphere which itself is rising very slowly in the rapidly outflowing material, at approximately 26 stellar radii (in 1965) above the invisible central star. There has also been some variation in radial velocity and spectral characteristics that may be linked with the erratic UBV fluctuations observed at Sonneberg. The observational data are discussed on the assumption that FG Sge is in process of producing another planetary nebula as it did once before, about 3000 years ago. (auth)

43772 A MODEL ATMOSPHERE FOR R CORONAE BOREALIS. **Myerscough, Valerie P. (Univ. of California, Berkeley). Astrophys. J., 153: 421-34(Aug. 1968).**

A grid of model atmospheres to analyze the carbon star R Coronae Borealis was constructed, using initially the abundance parameters obtained by Searle. The major sources of opacity near the surface are found to be C^- and electron scattering, while C and He contribute strongly in the deeper layers. The predicted output flux from the models in the red and near-infrared appears approximately independent of surface gravity for a given effective temperature, and comparison with scanner data (Spinrad and Taylor) leads to a probable effective temperature of 5800 ± 200°K for R CrB. A surface gravity of between about 0.1 and 1.0 is indicated from consistency of these models with observational data for the electron pressure and opacity (Warner); there is weak evidence that the star may be slightly metal-deficient. (auth)

43773 THEORETICAL MOLECULAR LINE ABSORPTION OF CO IN LATE-TYPE ATMOSPHERES. **Kunde, Virgil G. (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. J., 153: 435-50(Aug. 1968).**

The line positions, line intensities, and collisional line half-widths were calculated for the fundamental, first-overtone, and second-overtone vibration-rotation bands of $^{12}C^{16}O$ and $^{13}C^{16}O$. The $^{12}C^{16}O$ and $^{13}C^{16}O$ line intensities were computed for temperatures ranging from 175 to 3500°K and were weighted in accordance with a terrestrial $^{12}C/^{13}C$ abundance ratio. All lines within 5 to 6 orders of magnitude of the maximum line intensity of a band were considered (~4500 lines at 3500°K). The CO mass absorption coefficient was computed for several late-spectral-type stellar atmosphere conditions. The straight mean absorption coefficient was evaluated for these conditions in several ways: (1) exactly, by using line-by-line integration techniques; (2) approximately by using the quasi-random molecular absorption-band model; and (3) approximately by computing the expression $S_T^m/\Delta\nu$, where S_T^m is the total line intensity in a spectral interval $\Delta\nu$. Results of this investigation indicate that the simpler $S_T^m/\Delta\nu$ approximation represents the CO mean absorption coefficient in the late-type atmospheres generally to an accuracy better than 1% if the spectral intervals are greater than 5 cm^{-1}. The quoted accuracy is based on the fundamental band for $T = 2500$°K, pressures up to

2 atm, and turbulent velocities up to 10 km sec^{-1}. The mean absorption coefficient $S_T^m/\Delta\nu$ was determined for CO for temperatures of 1000, 2500, and 3500°K. (auth)

43774 FORMATION OF GRAPHITE GRAINS IN COOL STARS. **Donn, Bertram (Goddard Space Flight Center, Greenbelt, Md.); Wickramasinghe, N. C.; Hudson, J. P.; Stecher, T. P. Astrophys. J., 153: 451-64(Aug. 1968).**

The conditions for the formation of graphite grains in cool stars were examined on the basis of recently available molecular equilibrium data for stellar atmospheres. The Hoyle–Wickramasinghe mechanism for condensation in N stars was reexamined taking into account the presence of hydrogen, oxygen, and nitrogen. From Tsuji's tables, it was found that the partial pressure of free carbon in an N star exceeds the vapor pressure of bulk graphite when the temperature falls below 2400°K for a solar C/H ratio and at still lower temperatures for other abundances. Formation of graphite grains requires nucleation followed by crystal growth. Using classical nucleation theory, it is shown that the supersaturation p/p_{sat} required for graphite condensation on preexisting ions in the stellar atmosphere is only ~2.2. Such a supersaturation is reached when the temperature falls to ~2200°K in an N star with a solar C/H ratio $\approx 10^{-3}$, and at ~1500°K if C/H = 10^{-4}. Crystal growth proceeds sufficiently fast at the free-carbon pressures appropriate for temperatures greater than 1500°K to produce grain sizes exceeding 10^{-6} cm. The actual size to which particles grow is, however, restricted by the amount of available carbon and the number of effective condensation nuclei. With an ion density ~10^3 cm^{-3}, particle sizes ~5×10^{-6} cm would arise. Assuming a constant luminosity function, it is shown that 10^5 N stars in the Galaxy (at any time) operating over a time scale of 10^9 years would suffice to produce the required grain density to explain the interstellar extinction. The possibility that graphite particles may condense in the outer atmospheres of ordinary M giants is also discussed. Graphite condensation may take place to a limited extent in a region of the stellar atmosphere where the temperature falls to about 1600°K, provided that the effective C/O ratio is 1.3. Such a high effective C/O ratio cannot be ruled out, because of uncertainties in the relevant equilibrium calculations. (auth)

43775 THE EFFECT OF RAPID ROTATION ON RADIATION FROM STARS. II. THE ABSORPTION LINES. **Hardorp, Johannes (Univ. of Michigan, Ann Arbor); Strittmatter, Peter A. Astrophys. J., 153: 465-82(Aug. 1968).**

The effect of rapid uniform rotation on the profiles of Hγ, He I λ5875, He I λ4121, and Mg II λ4481 was computed for main-sequence stars in the mass range 1.5 to 8 $M_\odot$. It is shown that, owing principally to gravity darkening effects, the present rotational velocity–line broadening calibration yields values of v sin i which, depending on spectral type, may be 15 to 40% too small for stars rotating near their breakup velocity. Thus the broadest-lined stars observed in the spectral range B0–F0 are probably rotating at maximum speed, contrary to previous supposition. For purposes of abundance analysis, rotation should not cause serious error in determining atmospheric parameters from Hγ profiles or Balmer discontinuity in sharp-lined B and A stars. In particular, the apparent helium deficiency in certain main-sequence B stars cannot be explained in terms of aspect effects on rapidly rotating stars. However, rotation may produce errors of up to 0.5 mag in luminosity determinations from Balmer-line indices. Observational results in this connection are briefly discussed. (auth)

43776 EVOLUTION OF PROTOSTARS OF 1 AND 12 SOLAR MASSES. **Bodenheimer, Peter (Princeton Univ. Observatory, N. J.). Astrophys. J., 153: 483-94(Aug. 1968).**

An implicit method for performing hydrodynamic calculations, based on Henyey's scheme of stellar-evolution computation, is described. The method is applied to the calculation of the dynamic collapse of configurations representing protostars of 1 and 12 $M_\odot$. The evolutionary sequences are carried from an initial density of about 10^{-12} g cm^{-3} and a temperature on the order of 100°K to a final central density of about 10^{-2} g cm^{-3} and a central temperature of 25,000°K, at which point the buildup of the pressure gradient has resulted in the formation of a strong shock wave near the center. (auth)

43777 STUDIES IN STELLAR EVOLUTION. VI. EVOLUTION OF A 5 SOLAR MASS RED GIANT WITH MASS LOSS. **Forbes, J. E. (Univ. of California, Berkeley). Astrophys. J., 153: 495-510(Aug. 1968).**

The post-main-sequence evolution of a 5 $M_\odot$ star is calculated with mass loss during the giant phase, in an attempt to study the evolutionary effects of the mass ejection observed by Deutsch. An ad hoc prescription is used to calculate the rate of loss by assuming it to be proportional to the mass of the convective envelope; this confines the mass loss to the low-T_e extreme of the track. Two model sequences, II and III, are computed with mass loss, III having generally the higher rate, and the results are compared with a constant mass 5 sequence (I). The evolution is followed through the depletion of central helium and the establishment of a helium-burning shell source but not into the next nuclear phase (oxygen burning). The time scale of evolution is found to be rather insensitive to mass loss. II and III reach rather lower T_e values than I, but in the central regions they remain very similar to I even when their masses have been reduced to 1.64 and 0.97 $M_\odot$. Their final masses are 1.021 and 0.928 $M_\odot$. In spite of nearly a fivefold reduction in mass, II remains at all times rather similar to I, though at one point about 1 mag fainter. Sequence III, however, having only a slightly smaller mass than II, shows a radically changed behavior, its evolutionary track reaching a point near the main-sequence position of the original mass 5 star. The effect of mass loss on the times and durations of crossings of the Cepheid instability strip is examined. (auth)

43778 ASTRONOMICAL RADIATION MEASUREMENTS. I. SPECTROPHOTOMETRIC STANDARDS FOR ASTRONOMICAL USE. **Bless, R. C.; Code, A. D.; Schroeder, D. J. (Univ. of Wisconsin, Madison). Astrophys. J., 153: 545-56(Aug. 1968).**

Tungsten ribbon-filament lamps were calibrated against a freezing platinum black body over the wavelength interval 3400 to 10,000 Å for subsequent use as standards for stellar spectrophotometry. These lamps were compared with similar standards provided by the National Bureau of Standards, and both sets of lamps were also calibrated by an indirect pyrometric method. Results of this intercomparison of lamps and calibration techniques indicate that substantial errors may exist that significantly limit the accuracy of absolute stellar spectrophotometry, especially in the blue and ultraviolet. Calibration techniques shortward of 3000 Å are also discussed, and errors in such methods in this region of the spectrum are assessed. (auth)

43779 ASTRONOMICAL RADIATION MEASUREMENTS. II. OBSERVATIONS OF STARS IN THE SPECTRAL REGION λλ2800 TO 2100. Bless, R. C.; Code, A. D.; Houck, T. E.; McNall, J. F.; Taylor, D. J. (Univ. of Wisconsin, Madison). Astrophys. J., 153: 557-60(Aug. 1968).

A simple payload designed to measure the flux from stars in spectral bands at λλ2800, 2500, and 2100 was flown in an Aerobee rocket. Observations of about sixty stars are given. (auth)

43780 ASTRONOMICAL RADIATION MEASUREMENTS. III. AN ANALYSIS OF FAR-ULTRAVIOLET FILTER OBSERVATIONS OF STARS. **Bless, R. C.; Code, A. D.; Houck, T. E. (Univ. of Wisconsin, Madison). Astrophys. J., 153: 561-8(Aug. 1968).**

Filter observations of stars in the spectral region λλ2800 to 1100 were analyzed and the following was found: the best observational accuracy presently attained is about ±0.25 mag; blanketing by strong absorption lines within a filter pass band is the most important single factor affecting the comparison of observations and model atmospheres; blanketed models together with the Morton–Adams temperature scale adequately represent most ultraviolet observations of the thirty-five main-sequence stars analyzed; observations of a dozen giants show equally good agreement with models, though here a comparison was possible only in the λλ2000 to 2800 region; a value of the interstellar extinction at λ1115 was derived and is consistent with other determinations at longer wavelengths. (auth)

43781 THE COLOR-MAGNITUDE DIAGRAM FOR THE GLOBULAR CLUSTER NGC 5897. **Sandage, Allan; Katem, Basil (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Astrophys. J., 153: 569-75(Aug. 1968).**

The color–magnitude diagram of NGC 5897, derived from two-color photometry of 254 stars relative to a photoelectric sequence extending to V = 17.15, is characteristic of a globular cluster with low metal abundance. The magnitude difference, ΔV, between the giant branch at $(B - V)_0 = +1.4$ and the horizontal branch is 2.75 mag; the color of the subgiant branch at the magnitude level of the RR Lyrae gap is $(B - V)_{0,g} = +0.78$—values which suggest a metal abundance intermediate between extremely weak-lined clusters (Deutsch group C, Morgan class I) and moderately weak-lined clusters (Deutsch group B, Morgan classes II to III). Two new RR Lyrae stars and a new red variable near the top of the giant branch were isolated, bringing the total number of known variables to seven. The RR Lyrae gap occurs near V = 16.20. The apparent visual distance modulus is $(m - M)_{app, V} = 15.70$ if the gap has $M_V = +0.5$. The estimated reddening is $E(B - V) = +0.11 \pm 0.02$. If $A_V/E(B-V) = 3$, the true modulus is $(m-M)_0 = 15.37$, the distance from the Sun is 11,900 pc, and the height above the plane is 6000 pc. The absolute magnitude and linear diameter are $M_V = -7.3$, D = 54 pc, which require the average surface brightness to be 14 times smaller than that for M3. The low central concentration and large linear size are taken to mean that NGC 5897 has not suffered appreciable tidal evaporation by passage close to the galactic nucleus. (auth)

43782 OBSERVATIONS OF GALACTIC OH EMISSION. **Ball, J. A.; Meeks, M. L. (Massachusetts Inst. of Tech., Lexington). Astrophys. J., 153: 577-94(Aug. 1968).**

The 120-foot Haystack antenna of Massachusetts Institute of Technology Lincoln Laboratory was used to observe polarized OH emission in the galactic sources W49, NGC 6334, W51, and W75. Both the 1665 and 1667 MHz transitions were observed in W49 and NGC 6334, and only the 1665 MHz transition was observed in W51 and W75. The Stokes parameters were determined as functions of radial velocity, and the resulting spectra were decomposed into a set of independent, uniformly polarized features with Gaussian profiles. Half of the fifty-one observed features have a degree of polarization ≥90%. The polarization was circular in 70% of the features. Two bright, unpolarized features appear in the spectra of W51, and one feature in NGC 6334 appears to have nearly 100% linear polarization. Observations of NGC 6334 at irregular intervals from March 1966 through June 1967 disclosed intrinsic time variations in the more southern of a pair of OH source points in this region. Not all features showed variations, but two features with radial velocities -6.6 and -7.9 km sec^{-1} (1665 MHz) and one feature at -8.7 km sec^{-1} (1667 MHz) varied significantly in intervals of 9 days or longer. The time variations in the 1665 MHz features appear to be correlated. There is little apparent correlation in the radial velocities of 1665 and 1667 MHz features originating at the same position in W49 and NGC 6334. Of the four cases where such near coincidence is found, three cases show the same sense of circular polarization in both transitions. (auth)

43783 THE EXPANSION OF H II REGIONS. **Newman, R. C.; Axford, W. I. (Cornell Univ., Ithaca, N. Y.). Astrophys. J., 153: 595-614(Aug. 1968).**

The spherically symmetric expansion of H II regions is treated by dividing the problem into simpler subproblems on the basis of differing characteristic-length scales. A similarity solution is obtained for the flow in the H I and H II regions such that the density in the undisturbed H I region is constant and the ionizing flux from the central star varies as t^3, where t is the time. The H II region is taken to be isothermal and the H I region either isothermal or adiabatic. The ionization front, assumed to be a discontinuity in the similarity solutions for the large-scale flow, is studied in the approximation of one-dimensional steady flow, and allowed structures for given boundary conditions are obtained. The uniqueness and determinacy of the overall solution are considered. Shocks are treated as discontinuities throughout, being uniquely determined by the Rankine–Hugoniot relations and the requirement that they be compressive. A simplified approach to the problem is found to yield results which are, on the whole, in good agreement with the more exact treatment described. This suggests that more general problems which do not have similarity solutions can be treated with fair accuracy in this manner. (auth)

43784 SUPRALUMINOUS WAVES IN ASTROPHYSICAL PLASMAS. **Lerche, I. (Univ. of Chicago). Astrophys. J., 153: 615-26(Aug. 1968).**

It has been shown recently that thermal excitation in a plasma leads to the excitation of waves with phase velocities in excess of light and that these "supraluminous" waves propagate undamped in a collisionless plasma. A simple physical exposition is given here of the generation and maintenance of the equilibrium spectrum of supraluminous electrostatic and electromagnetic waves in a collisionless, thermal plasma. In the absence of any imbedded fields, and for a spatially homogeneous plasma, such waves may transport large amounts of energy through the plasma. The scattering of such undamped waves by "small" inhomogeneities causes the plasma to emit electromagnetic radiation. The power output of the emitted waves is computed for thermal radio sources using parameters appropriate to the Crab Nebula. It is demonstrated that such radiation may be comparable to synchrotron radiation; it is produced mainly in the megacycle band. The implications of this energy output for (a) observing radio sources, (b) heating H I and H II regions, (c) increasing the energy requirements of radio sources, and (d) transferring heat within the nebula are discussed. (auth)

43785 DUST AND ATOMIC HYDROGEN IN INTERSTELLAR SPACE. **Varsavsky, Carlos M. (Instituto Argentino de Radioastronomia, Buenos Aires). Astrophys. J., 153: 627-32(Aug. 1968).**

The relative abundance of atomic hydrogen to dust grains as a function of grain density was studied and it was found that in dark dust clouds hydrogen becomes practically all molecular. The depletion of atomic hydrogen with respect to the "normal" galactic value is proportional to the amount of grain surface per unit volume and the time elapsed since the cloud was last ionized by a hot star. (auth)

43786 TWO-DIMENSIONAL STELLAR COLLISIONS. **DeYoung, David S. (Cornell Univ., Ithaca, N. Y.). Astrophys. J., 153: 633-42(Aug. 1968).**

A head-on collision between two solar-type stars with a relative velocity of 5000 km sec^{-1} is considered in a two-dimensional regime. Propagation of the resulting shock front is calculated, together with the outflow of material behind the shock. The production of relativistic ejecta is found to proceed with an efficiency of a few per cent, placing strong requirements on using the collision mechanism as an energy source for quasi-stellar objects. (auth)

43787 RELATIVISTIC STELLAR DYNAMICS. **Fackerell, Edward D. (Monash Univ., Melbourne). Astrophys. J., 153: 643-60(Aug. 1968).**

The theory of stellar dynamics is developed within the framework of general relativity for time-independent, spherically symmetric systems in which collisions are ignored, and a criterion is obtained for the applicability of this theory. It is shown how the distribution function may be found for systems with an isotropic pressure if either the energy density of the system is given as a function of the radius or an "equation of state" is assumed. The nonexistence of isotropic models with constant energy density is demonstrated by showing that the distribution function so found is negative over an essential part of its range. Explicit distribution functions are found for systems corresponding to Tooper's general relativistic polytropes of indices n = 1.0(0.5)3.0. For a given polytropic index the relativity parameter σ defined as the ratio of the pressure to the energy density at the center of the system is found to have an upper limit σ_n set by the requirement that the distribution function should be nonnegative. In every case examined $\sigma_n < n/(n + 1)$, so that the speed of propagation of small disturbances in these systems is always less than the speed of light, and furthermore $2GM/c^2R$ is always less than unity, so that the Schwarzschild singularity never occurs in these systems. (auth)

43788 SPATIALLY HOMOGENEOUS AND EUCLIDEAN COSMOLOGICAL MODELS WITH SHEAR. **Jacobs, Kenneth C. (California Inst. of Tech., Pasadena). Astrophys. J., 153: 661-78(Aug. 1968).**

Spatially homogeneous universes with the anisotropic, Euclidean metric $ds^2 = dt^2 - A^2(t)dx^2 - B^2(t)dy^2 - W^2(t)dz^2$ were studied in some detail. Matter with the equation of state $p_M = \gamma\rho_M$ and a uniform magnetic field, in various combinations, constitute the stress-energy tensor $T^{\mu\nu}$. The general solution for the case with no magnetic field was derived. This solution was used to construct several semi-realistic cosmological models of the Universe, in which were investigated (a) primordial element formation, (b) the time when anisotropies become small, and (c) possible temperature anisotropy of the observed 3°K cosmic microwave radiation. (auth)

43789 A SYSTEMATIC METHOD FOR IDENTIFYING ABSORPTION LINES AS APPLIED TO PKS 0237 - 23. **Bahcall, John N. (California Inst. of Tech., Pasadena). Astrophys. J., 153: 679-88(Aug. 1968).**

A systematic method for identifying the absorption lines in quasi-stellar sources with rich absorption spectra is described, and the lines that are expected on theoretical grounds to have the highest probability of appearing in absorption in quasi-stellar sources are listed. The computational scheme that was developed for recognizing and analyzing candidate redshifts is then described; this computational scheme is supplemented by a set of rules used to determine if a candidate redshift is acceptable. The computational scheme and formal rules were applied to a set of nonsense spectra, i.e., random-number spectra, with the same main characteristics as the absorption spectrum of PKS 0237-23 determined by Greenstein and Sargent. The average number of acceptable redshifts per nonsense spectrum was 0.7. Five acceptable redshifts were found in the real spectrum: z = 2.2015, 1.671, 1.656, 1.513, and 1.364. No acceptable redshift was found at z = 1.95. A list of additional lines that should be detectable if the identifications proposed here are correct is given for slightly longer and shorter wavelengths than covered in the observations of Greenstein and Sargent. Some characteristics of the identifications are also described. (auth)

43790 THE ABSORPTION-LINE SPECTRUM OF THE QUASI-STELLAR RADIO SOURCE PKS 0237 - 23. **Bahcall, John N. (California Inst. of Tech., Pasadena); Greenstein, Jesse L.; Sargent, Wallace L. W. Astrophys. J., 153: 689-98(Aug. 1968).**

The wavelengths of 49 absorption lines measured in the wavelength range $\lambda\lambda$3300 to 4800 in the spectrum of the quasi-stellar radio source PKS 0237-23 are presented. Equivalent widths, half-widths, and central depths are given for thirty-eight of these lines having $\lambda > 3650$ Å. A systematic procedure has been used by Bahcall (1968) to identify twenty-eight of the lines with five absorption redshifts, namely, $z = 2.2015$, 1.6706, 1.6560, 1.5132, and 1.3642. There is no strong evidence for an absorption redshift of $z = 1.95$, found by earlier workers. It is presumed that the absorption lines in PKS 0237-23 arise either in intergalactic space or in clouds which are near the object and moving at speeds of up to 0.3 c relative to the source of the emission lines. At present there is no compelling argument or observation to distinguish between these two hypotheses. (auth)

43791 REMARKS ON THE PECULIAR GALAXY MCG 12-7-28. **de Vaucouleurs, G.; de Vaucouleurs, A. (Univ. of Texas, Austin). Astrophys. J., 153: 699-700(Aug. 1968).**

The peculiar galaxy, described by Burbidge, Burbidge, and Shelton (1967) as a newly discovered object, is a known catalogued system; it is MCG 12-7-28 (No. 28 on Palomar Chart 665) in Vorontsov-Velyaminov's Morphological Catalogue, Part I (1962). It is also included as A0706 with a brief description in a recent list by the authors (1967). (W.D.M.)

43792 SOLAR FLARE INJECTION AND PROPAGATION OF LOW-ENERGY PROTONS AND ELECTRONS IN THE EVENT OF JULY 7-9, 1966. Lin, R. P. (Univ. of California, Berkeley); Kahler, S. W.; Roelof, E. C. Solar Phys., 4: 338-60(July 1968).

Simultaneous observations of the 7 to 9 July 1966 solar particle event by energetic particle detectors on three satellites, IMP-III, OGO-III and Explorer 33 are utilized to show that large spatial gradients are present in the fluxes of 0.5 to 20 MeV protons and $\gtrsim$45 keV electrons. The event is divided into three parts: the ordinary diffusive component, the halo, and the core. The core corotates with the interplanetary field, and therefore it and the surrounding halo are interpreted as spatial features which are connected by the interplanetary magnetic field lines to the vicinity of the flare region. Upper limits to the interplanetary transverse diffusion coefficient for 4 to 20 MeV protons at 1 AU are derived from the width of the halo. These are at least two orders of magnitude less than the parallel diffusion coefficient for the same energy particles. It is argued that the observed flux variations cannot be explained by an impulsive point source injection for any physically reasonable diffusion model. Instead, since the interplanetary transverse-diffusion coefficient is small for these low-energy particles, the observed spatial features are interpreted as the projection to 1 AU by the interplanetary field lines of an extensive injection profile at the sun. The geometry of the injection mechanism is discussed and it is suggested that some temporary storage of the flare particles occurs near the sun. (auth)

43793 MOTIONS AND MAGNETIC FIELDS IN QUIESCENT PROMINENCES. Malville, J. McKim (High Altitude Observatory, Boulder, Colo.). Solar Phys., 4: 323-31(July 1968).

An observed relation between line-of-sight velocities and the longitudinal component of the magnetic field in quiescent prominences is discussed. Weak fields in quiescent prominences are associated with large velocities determined from Doppler shifts of resolved emission knots and Doppler line widths measured in Ca II K line. It is suggested that the observed irregular motions in prominences are driven by photospheric horizontal convection coupled by the prominence magnetic field. An energy flux of 3×10^5 ergs cm^{-2} sec^{-1} present in the form of Alfvén waves in quiescent prominences is consistent with the observations. (auth)

43794 HIGH-RESOLUTION PHOTOGRAPHY OF THE SOLAR CHROMOSPHERE. II. THE RELATIONSHIP BETWEEN CHROMOSPHERIC AND PHOTOSPHERIC FACULAE. Bray, R. J. (Commonwealth Scientific and Industrial Research Organization, Sydney). Solar Phys., 4: 318-22(July 1968).

It is pointed out that present observations indicate that the correlation between chromospheric and photospheric faculae is weaker, or at least less obvious, than has been previously supposed. (TSS)

43795 ON A PECULIARITY OF THE π COMPONENT OF A NORMAL TRIPLET IN THE UMBRA OF A SUNSPOT. Henoux, J. C. (Observatoire de Paris, Meudon, France). Solar Phys., 4: 315-17(July 1968). (In French).

Sometimes the π component of a normal triplet in the umbra of sunspots, observed with a quarter-plate analyser, seems to be circularly polarized. This effect is explained as a saturation effect. (auth)

43796 THE INTENSITY, VELOCITY, AND MAGNETIC STRUCTURE OF A SUNSPOT REGION. II. SOME PROPERTIES OF UMBRAL DOTS. Beckers, J. M. (Sacramento Peak Observatory, Sunspot, N. Mex.); Schroeter, E. H. Solar Phys., 4: 303-14(July 1968).

A time sequence of high-resolution sunspot photographs, exposed almost simultaneously in two continuum wavelengths (4680 Å and 6400 Å), was used to study some properties of umbral fine structures ("umbral dots"). The lifetime of the umbral dots is found to be 1500 sec. Photometry of some bright dots leads to an observed intensity excess of 0.129 I_{phot} and 0.134 I_{phot} in the blue and red, respectively. The observed mean diameter of the dots is found to be 420 km. These values still include the action of image blurring. From the color index the true intensity and diameter of the dots are estimated. It appears that the umbral dots are in reality of photospheric brightness having true diameters of 150 to 200 km. The spatial distribution of the dots in sunspot umbrae is discussed. Some peculiarities in recent sunspot magnetic-field observations may be explained by magnetic inhomogeneities associated with umbral dots. (auth)

43797 ON THE DIFFERENCE BETWEEN THE PHOTOMETRIC INHOMOGENEITIES OF THE SOLAR SURFACE IN TWO COLORS. Vassil'eva, G. (Pulkovo Observatory, Moscow). Solar Phys., 4: 300-2(July 1968).

It has been observed that an excess of brightness of some inhomogeneities occurs in a limited spectral range, and that the pictures of the inhomogeneities in two different colors are different. However, Evans has shown that the structure of the solar granulation is not greatly different in widely separated colors. Possible sources for this discrepancy are considered. (TSS)

43798 A NEW METHOD OF MAGNETOGRAPH OBSERVATION OF THE PHOTOSPHERIC BRIGHTNESS, VELOCITY, AND MAGNETIC FIELDS. Howard, Robert Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena); Tanenbaum, Andrew S.; Wilcox, John M. Solar Phys., 4: 286-99(July 1968).

Several improvements were made to the Mount Wilson Observatory solar magnetograph, including changes to the guider, the Doppler compensator, and the data-handling system. The improved magnetograph was used for a new type of solar observation consisting of several hundred scans back and forth along a straight line of length $\frac{3}{4}$ $R_{\odot}$ perpendicular to central meridian. The data reduction, which is done entirely with a computer, eliminates those effects which have their origin in the earth-sun geometry. The spatial and temporal properties of the 5-min oscillations are discussed. (auth)

43799 SOME RESULTS OF A SPECTROPHOTOMETRIC STUDY OF V 444 CYG. Ivanova, N. L.; Oganesyan, R. Kh.; Epremyan, R. A. Astrophysics (Engl. Transl.), 1: 211-14 (Oct.-Dec. 1965).

Translated from Astrofizika, 1: 397-404(1965).

The results of a spectrophotometric study of the spectroscopic binary V 444 Cyg are given. After correction of the absolute gradients for interstellar absorption, the following changes in the energy distribution of the star with change of phase were established: (1) the color temperature of V 444 Cyg at maximum brightness corresponds in the photographic region to the temperature of A2-type stars ($P_1 = 1.25$, $T_1 = 12{,}000°$), and in the ultraviolet to spectra type BO ($P_2 = 0.75$, $T_2 = 20{,}000°$); (2) a decrease of color temperature is observed during primary and secondary minima; and (3) there is a clear decrease of color temperature both in the photographic and in the ultraviolet regions at phase 0.4. (auth)

43800 GALAXIES WITH FREQUENT SUPERNOVA EXPLOSIONS. Kukarkin, B. V. Astrophysics (Engl. Transl.), 1: 245-7 (Oct.-Dec. 1965).

Translated from Astrofizika, 1: 465-72(1965).

Eight galaxies are already known in which supernovae have flared two or more times. Among these galaxies seven are spirals of class Sc(SBc) with high luminosity. Supernovae of almost all types have exploded in these galaxies. The frequency of appearance of supernovae in these galaxies is in any case not less than one per 15 years. The frequency of appearance of type-I supernovae is in any case not less than one per 35 years. These frequencies are many times greater than the usually accepted values. It is extremely desirable to organize systematic observations of class Sc(SBc) high luminosity galaxies. (auth)

43801 COMMENTS ON THE QUESTION OF THE FREQUENCY OF SUPERNOVAE. Ambartsumyan, V. A. Astrophysics (Engl. Transl.), 1: 248(Oct.-Dec. 1965).

Translated from Astrofizika, 1: 473-4(1965).

The article by Kukarkin (see preceding abstract) discussed the very important problem of differences in the frequencies of supernovae in different physical types of galaxies. He concludes that Sc galaxies (and especially those of high luminosity) exhibit a high flare frequency. Three points are discussed which emphasize still more clearly the special position of Sc galaxies in relation to supernova frequency. (W.D.M.)

43802 SHOCK WAVES IN A GAS-DUST MEDIUM. Gidalevich, E. Ya.; Kaplan, S. A. Astrophysics (Engl. Transl.), 1: 249(Oct.-Dec. 1965).

Translated from Astrofizika, 1: 475-7(1965).

When shock waves form in a gas-dust medium there is a separation of the gas and dust components. If there is a jump in the shock-wave velocity of the gas at the front, the dust particles hardly change their velocity within the limits of the shock front. As a result, directly behind the shock front, the velocities of the gas and dust are different and are equalized only at some distance from the front. The structure of this region of equalization can be computed by solving the ordinary system of hydrodynamic equations, supplemented by an equation describing the change in the systematic velocity of the dust component under the influence of the dynamic pressure of the gas flow. (W.D.M.)

43803 ON A METHOD FOR THE APPROXIMATE COMPUTATION OF SUPERDENSE CONFIGURATIONS. Chubaryan, E. V.; Mnatsakanyan, M. A. Astrophysics (Engl. Transl.), 1: 250-1 (Oct.-Dec. 1965).

Translated from Astrofizika, 1: 477-9(1965).

The purpose of this communication is to demonstrate that it is feasible to make an approximate semi-analytical integration of the equations for the parameters of spherically symmetrical superdense cold configurations. The proposed method, as compared with the Runge-Kutta method, considerably facilitates the computations, which is important if the latter are made manually. This method may be useful in preliminary investigations of such problems before computer calculations are made. (W.D.M.)

43804 AN INVESTIGATION OF THE SPECTRUM OF RW AUR. Kharadze, E. K.; Bartaya, R. A. Astrophysics (Engl. Transl.), 1: 215-20(Oct.-Dec. 1965).

Translated from Astrofizika, 1: 405-16(1965).

The relative energy distribution in the continuous spectrum of RW Aur was investigated. Monochromatic brightness curves Δm_{3650}, Δm_{4340}, and Δm_{5550} were constructed. The B-V and U-V variations were considered as a function of star brightness. The results indicate that continuous ultraviolet emission is, to a greater or lesser degree, always present; for this reason the star brightness is at all times greater in the U region than in the B region. However, the variability of the total star brightness is due for the most part to thermal emission, that is, the energy release occurs for the most part in the deeper layers of the photosphere. (auth)

43805 COLORIMETRIC INVESTIGATION OF THE COMETARY NEBULA ANON 6^h04^m. Khachikyan, E. E.; Parsamyan, E. S. Astrophysics (Engl. Transl.), 1: 221-7(Oct.-Dec. 1965).

Translated from Astrofizika, 1: 417-28(1965).

The results of a colorimetric investigation of the bipartite cometary nebula Anon 6^h04^m are presented. The photographs were taken with the 40" Schmidt telescope of the Byurakan Astrophysical Observatory on a system similar to the UBV system. The photographs were calibrated and standardized using extrafocal images of the standard NPS region. Maps of the B-V, U-B, and B distributions in the nebula are given. The integral brightness of the nebula was measured in three colors. The northern part of the nebula was brighter than the southern part by one stellar magnitude in U and by half a magnitude in B and V. Graphs showing the dependence of the B-V and U-B values on B and graphs of nebular isophotes in the three colors are given. Graphs of the dependence of ln I on distance r to the nucleus were constructed to determine the brightness gradient in the nebula. The intensity decrease is represented satisfactorily by the formula $I = I_0 \exp(-k_\lambda r)$. The values of k_λ in the three spectral regions U, B, V are estimated for both parts of the nebula. It is shown that the brightness of the nebula exceeds by three stellar magnitudes the brightness predicted by the Hubble relation. It is concluded that the luminescence of the nebula Anon 6^h04^m cannot be attributed solely to reflection of the light of the central star. (auth)

43806 CORRELATION BETWEEN THE DIRECTION OF THE AXES OF COMETARY NEBULAE AND THE PLANES OF POLARIZATION OF NEARBY STARS. Vardanyan, R. A. Astrophysics (Engl. Transl.), 1: 229-31(Oct.-Dec. 1965).

Translated from Astrofizika, 1: 429-36(1965).

It is demonstrated that the directions of the axes of cometary nebulae coincide with the mean plane of polarization of nearby stars. It is concluded that the orientation of the axes of cometary nebulae is governed by the general galactic or local magnetic fields. (auth)

43807 ON THE POSSIBLILITY OF DETERMINING THE AGE OF GLOBULAR CLUSTERS BY A DYNAMICAL METHOD. Petrovskaya, I. V. (Leningrad State Univ.). Astrophysics (Engl. Transl.), 1: 233-40(Oct.-Dec. 1965).

Translated from Astrofizika, 1: 437-54(1965).

The observed density distribution in globular clusters is compared with the theoretical distributions obtained for a cluster with a small nucleus in quasi-equilibrium and for a cluster attaining a quasi-equilibrium state as a whole. In each case the observed distribution is intermediate between the two theoretical distributions. This makes it possible to estimate the evolutionary stage and to determine a dynamical age for the cluster. The evolutionary stage has been determined for 50 globular clusters investigated by Kron and Mayall by the photoelectric method. The mean relaxation time and age were computed for 34 clusters with known absolute magnitudes and linear diameters on the basis of data given by Kron and Mayall, Lohmann, and Bredikhin. Disk clusters, which do not contain variables of the RR Lyr-type, and which have a higher metal content, are on the average 1.4 to 1.7 times younger than halo clusters. The older clusters are on the average brighter than the younger ones. (auth)

43808 BN ORI-A STAR OF THE RW AUR TYPE. Dragomiretskaya, B. A. Astrophysics (Engl. Transl.), 1: 241-4(Oct.-Dec. 1965).

Translated from Astrofizika, 1: 455-64(1965).

The brightness fluctuations and color indices of the semiregular star BN Ori were investigated. It is demonstrated that the brightness changes consist of an alternation of variable and quiet periods separately by approximately 10,000 days. The color index varies over a range of 1.2 magnitudes. The star becomes yellower at minimum. The change of the color index as a function of brightness was also investigated. (auth)

43809 ON THE CONTINUOUS EMISSION OF SS CYG. Mirzoyan, L. V.; Kalloglyan, N. L. Astrophysics (Engl. Transl.), 1: 203-9(Oct.-Dec. 1965).

Translated from Astrofizika, 1: 385-96(1965).

The energy distribution in the continuous spectrum of SS Cyg was investigated. The study was made using objective-prism spectra obtained on the 8" and 40" Schmidt telescopes of the Byurakan Astrophysical Observatory. It was found that the continuous spectrum of the star contains an excess short-wave radiation of a nonthermal character (continuous emission) at minimum. It is shown that the earlier observations of Hinderer and Zuckermann are in agreement with this result and indicate the existence of continuous emission in the stellar spectrum, sometimes even at maximum. (auth)

43810 DETERMINATION OF THE CHANGE OF GALACTIC ROTATION IN THE Z-DIRECTION FROM THE LINE PROFILES OF NEUTRAL HYDROGEN. Agekyan, T. A.; Petrovskaya, I. V.; Fesenko, B. I. (Leningrad State Univ.). Astrophysics (Engl. Transl.), 1: 197-202(Oct.-Dec. 1965).

Translated from Astrofizika, 1: 373-84(1965).

A method is proposed for determining the rotational velocity of the neutral hydrogen subsystem in the outer regions of the Galaxy outside the galactic plane. The rotational velocity of neutral hydrogen decreases on the average by 5 to 10 km/sec at a distance of 0.01 from the galactic plane and at 1.2 to 1.4 from the center of the Galaxy (the distances are expressed in terms of the Sun distance from the galactic center). The rotational curve for the neutral hydrogen subsystem in the outer regions of the galactic plane was refined. (auth)

43811 HYDROGEN AND HELIUM ION IMPLANTATION INTO OLIVINE AND ENSTATITE: RETENTION COEFFICIENTS, SATURATION CONCENTRATIONS, AND TEMPERATURE-RELEASE PROFILES. Lord, H. C. (Univ. of California, San Diego, La Jolla). J. Geophys. Res., 73: 5271-80(Aug. 15, 1968).

Low-energy ions, as from the solar wind, penetrate the surface of exposed samples. The retention coefficients, saturation concentrations, and gas-release curves for the predominant solar-wind species, hydrogen and helium, were determined for olivine and enstatite. Forsterite, fayalite, and enstatite samples that had been irradiated with 1.8-keV helium ions and forsterite that had been irradiated with 2-keV hydrogen ions were degassed in controlled heating experiments. The concentration of the evolved gas was measured with a thermal conductivity detector gas chromatograph. In forsterite the hydrogen retention coefficient for an incident dose of 5.4×10^{16} ions/cm^2 was found to be approximately 0.9. For 6.1×10^{16} helium ions/cm^2 the observed retention coefficients are approximately 0.2 for enstatite, 0.2 for single-crystal forsterite, and 0.4 for dunite (fine-grained forsterite). Decreased retention with increased dose (saturation effect) is observed; saturation of 2-keV hydrogen ions in single-crystal forsterite occurred at 5×10^{17} cm^{-2}; saturation of 1.8-keV helium ions in single-crystal forsterite, fayalite, and enstatite occurred at about 6×10^{16} cm^{-2}. Saturation of 1.8-keV helium ions in dunite (fine-grained forsterite) was not detected, but it was concluded to occur above 1 × 10^{17} cm^{-2}. The temperature for the onset of release of the trapped gas was found to correspond approximately to the irradiation temperature. Increased sample temperature at a given irradiation dose resulted in decreased retention. For any comparable irradiation, the helium release occurs at a lower temperature than the hydrogen release. The saturation concentration of 1.8-keV helium in enstatite or olivine, about 6 × 10^{16} cm^{-2} for a uniform irradiation of 30-μ diameter grains, would give 1.3 cc STP He/cm^2. Saturation would be reached in a few hundred years of solar-wind bombardment at 1 AU. (auth)

43812 THE BRIGHTEST VARIABLE IN THE GLOBULAR CLUSTER ω CENTAURI. Jones, D. H. P. (Radcliffe Observatory, Pretoria. Mon. Notic. Roy. Astron. Soc., 140: 265-72(1968).

Eighteen spectra of this variable were secured at a dispersion of 86 Å/mm. The radial velocity and spectrum variations are discussed and compared with the photoelectric light and color curves. The mean radial velocity is +210 ± 2 km s^{-1}, and the radial velocity amplitude is 25 km s^{-1}. The median spectral type of the metal lines is F0 Ib. This variable is intermediate in its characteristics between the Population II cepheids and the RV Tauri stars, although hotter than most stars of the latter class. The Balmer lines of hydrogen show marked changes in absorption, disappearing at the middle of the rising branch. Emission lines do not appear at any phase. An interstellar K line is probably present. (auth) (UK)

43813 MASS FLOW FROM STELLAR SYSTEMS. I. RADIAL FLOW FROM SPHERICAL SYSTEMS. Burke, J. Anthony (Brandeis Univ., Walham, Mass.). Mon. Notic. Roy. Astron. Soc., 140: 241-54(1968).

Evidence indicates that interstellar material exists within some Population-II stellar systems. With a view to understanding the behavior of this material, a simplified model stellar system is outlined in which it is assumed that: (i) interstellar material is injected into the system by its stellar component; (ii) a radial, outward flow pattern is established; and (iii) the flow is in steady state. Solutions of the differential equations governing the model give quantitative results for the velocity, temperature, and density of the interstellar matter in globular clusters and elliptical galaxies. It is seen that for the more tightly bound elliptical galaxies solutions do not exist, indicating that material does not escape in a radial, steady state flow pattern, but probably remains within the galaxy. (auth) (UK)

43814 RELATION OF COSMOLOGY TO SOME BASIC PRINCIPLES OF PHYSICS. Unsoeld, A. (Institut fuer Theoretische Physik und Sternwarte, Kiel). Naturwissenschaften, 55: 225(May 1968). (In German).

The Hubble relation for the velocity of cosmic objects can be explained, in the framework of the general relativity theory and present knowledge on the material/filling of the Universe, by a series of mechanical space models which vary significantly from each other with respect to their behavior in the far past and the far future. The nonvalidity of basic laws of physics in cosmology leads to the question of whether these nonvalidities can be considered with respect to the interaction laws of elementary particles. (J.S.R.)

43815 MERIDIAN CIRCULATION. Maheswaran, M. (Cambridge Univ.). Mon. Notic. Roy. Astron. Soc., 140: 93-107(1968).

The meridian circulation velocities in the radiative envelope of a Cowling model star are calculated using a second-order perturbation expansion, and it is shown that the circulation breaks up into two regions, as obtained by Öpik, and that the velocity near the surface becomes large as in the case of the first order velocity for nonuniform rotation (Baker & Kippenhahn (1959)). This shows that Sweet's (1950) first-order perturbation method is inadequate for uniform rotation. Possible steady state structures with rotations slightly perturbed from uniform rotation are also investigated, and it is shown that for perturbations of about 3% or less from uniform rotation, structures which are in almost steady circulation can be obtained. For larger perturbations of a specified form the circulation breaks up into four regions. (auth) (UK)

43816 JEANS'S TYPE GRAVITATIONAL INSTABILITY OF FINITE ISOTHERMAL GAS SPHERES. Yabushita, Shin (Kyoto Univ.). Mon. Notic. Roy. Astron. Soc., 140: 109-20(1968).

It is shown that infinitely large isothermal gas spheres are unstable if γ (the ratio of the specific heats) is between 1.0 and 1.28. If γ is greater than a value slightly smaller than $^5/_3$, the spheres are stable. It is known that for a finite isothermal gas sphere surrounded by an external medium, there exists a maximum external pressure (p_c) that the gas sphere with a given temperature can withstand. It is shown that if motion about equilibrium takes place isothermally ($\gamma = 1$), the Jeans's type instability sets in precisely at the point of maximum pressure. If the motion takes place adiabatically, with a value of γ between 1.0 and 1.28, the instability sets in at a state more compressed than the state of maximum pressure. (auth) (UK)

43817 DISTRIBUTION OF ROTATIONAL VELOCITIES IN Be STARS. Stoeckley, Thomas R. (Cambridge Observatories, Eng.). Mon. Notic. Roy. Astron. Soc., 140: 141-7(1968).

It is shown that the observed absorption line widths of Be stars can be understood on the hypothesis that these stars are rotating near equatorial breakup velocity, if the published values of v_e sin i are corrected to take account of second-order effects of rapid rotation on absorption line profiles. (auth) (UK)

43818 OUTER CONVECTION ZONE IN STARS. Shaviv, G.; Chitre, S. M. (California Inst. of Tech., Pasadena). Mon. Notic. Roy. Astron. Soc., 140: 61-9(1968).

The model of convection by Faulkner, Griffith, and Hoyle (Mon. Notic. Roy. Astron. Soc., 129: 363-9(1965)) is modified to take into account the aerodynamic drag experienced by moving convective elements. It is found that the velocity field so obtained accords better with the observed motions in the solar granulation. (auth) (UK)

43819 MEASUREMENT DATA OF SOME RADIO SOURCES AT THE WAVELENGTH 5.2 cm. Matveenko, L. I.; Kostenko, V. I.; Sorochenko, R. L.; Zotov, V. V. Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 682-8(1968). (In Russian).

The methods and measurement results of radio emission from some quasars and Seyfert galaxy NGC 1275 are considered. Their flux densities at the wavelength 5.2 cm are given. Some sources have a change in the flux density of radiation. (auth)

43820 DISCOVERY OF TWO SOUTHERN PULSARS. Turtle, A. J.; Vaughan, A. E. (Univ. of Sydney). Nature (London), 219: 689-90(Aug. 17, 1968).

Two pulsating radio sources have been discovered in the southern hemisphere sky. One of the sources had a period of 1.961s, the longest yet announced. (auth) (UK)

43821 ABSORPTION FEATURES IN THE OPTICAL SPECTRA OF QUASI-STELLAR OBJECTS. Piper, D. E. Quart. J. Roy. Astron. Soc., 9: 116-35(June 1968).

The problems which have arisen in the course of various attempts to interpret the absorption spectra are reviewed. One such problem is that absorption times appear preferentially in the spectra of those quasars with the largest values of emission red shift. Another feature is that the red shifts of the absorption lines not only do not coincide, in general, with those of the emission lines in the same spectrum, but when they differ by more than a small amount show an invariable tendency to cluster close to a fixed value of about 1.95, which thus seems to have some intrinsic significance. Evidence has also been obtained which points towards the existence of a correlation between $\Delta Z = \overline{Z}_{em} - Z_{ab}$ (where $\overline{Z}_{em}$ is the mean red shift derived from the emission lines and Z_{ab} the red shift of an individual absorption) and the ionization potential of the ion or atom containing one more electron than that responsible for the absorption. These problems are discussed with reference to experimental results. (UK)

43822 REGULARITY AND BOUNDARY CONDITIONS FOR GENERAL RELATIVISTIC FLUID SPHERES. Kuchowicz, B. (Univ. of Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys., 16: 437-43(1968).

Recently the author derived certain new solutions of Einstein's field equations (1966, 1967). It is of interest to find certain general indications resulting from a limiting behavior of these solutions. This could be of help in finding other exact solutions of the field equations. The present paper is thus devoted to investigation of the regularity and boundary conditions, and the results derived in the sequel are valid with only the restrictions mentioned in the text. (W.D.M.)

43823 RADIO SPECTRA OF THE NEBULA IC443. Kundu, M. R.; Velusamy, T. (Tata Inst. of Fundamental Research, Bombay). Mon. Notic. Roy. Astron. Soc., 140: 173-6(1968).

Combining observations at 430 and 195 MHz with pencil beams of 17′ and 35′ arc respectively with other high-resolution observations at 750, 1400, 3000, and 5000 MHz, the flux density spectrum over different regions of the shell source IC443 was computed. It appears that the northeast bright rim or shell has a curved spectrum with spectral index of 0.1 and 0.35 below and above 750 MHz. The other regions exhibit a straight line spectrum with spectral index of about 0.4. (auth) (UK)

43824 MAGNETIC BRAKING BY A STELLAR WIND. II. Mestel, L. (Univ. of Manchester, Eng.). Mon. Notic. Roy. Astron. Soc., 140: 177-96(1968).

The theory developed in Paper I (Mestel, L., 1968. Mon. Not. R. Astr. Soc., 138: 359) is extended to apply to stars with the magnetic dipole inclined to the rotation axis at an arbitrary angle χ. It is shown that in addition to the principal component of the magnetic torque, acting along the rotation axis and tending to brake the star, there are components along the two perpendicular axes which cause the rotation axis to precess through the star. These components vanish when $\chi = o$—the axisymmetric case of I—or $\chi = \pi/2$; detailed numerical work will determine whether the asymptotic state reached by the star is with $\chi = o, \pi/2$, or possibly some intermediate value. (auth) (UK)

43825 THE ABUNDANCES OF THE ELEMENTS IN THE SOLAR PHOTOSPHERE. V. THE ALKALINE EARTHS Mg, Ca, Sr, Ba. Lambert, D. L.; Warner, B. (California Inst. of Tech., Pasadena). Mon. Notic. Roy. Astron. Soc., 140: 197-221(1968).

A detailed account is given of available solar absorption lines arising from the neutral and ionized alkaline earth elements. Careful use of theoretical and experimental oscillator strengths leads to the following revised abundances, on the scale where log N(H) = 12.00: log N(Mg) = 7.48, log N(Ca) = 6.33, log N(Sr) = 2.82, and log N(Ba) = 1.90. (auth) (UK)

43826 EVOLUTION OF HELIUM SHELL-BURNING STARS. Faulkner, D. J. (Australian National Univ., Canberra). Mon. Notic. Roy. Astron. Soc., 140: 223-33(1968).

Evolutionary sequences of helium shell-burning models were constructed, using the Henyey method, for stars of mass $0.8M_\odot$, $0.9M_\odot$, and $1.0M_\odot$. The starting point of each sequence is a star with a core of carbon and oxygen, comprising 25% of the star's mass, surrounded by helium-rich material. No neutrino energy-loss processes were considered in this investigation. At each of the masses considered, the temperature in the core eventually becomes high enough for carbon-burning to commence; when this occurs, the layers immediately surrounding the core expand and the helium-burning shell dies out. The star then settles down to a phase of carbon-burning in a convective core. The latter parts of the computed tracks in the Hertzsprung–Russell diagram match the observed track for the nuclei of planetary nebulae moderately well; the computed times of evolution are longer than the observed time by a factor of five to ten. They are, however, considerably shorter than the evolution times obtained (in the absence of neutrino processes) for stars without shell-burning, and it appears that the inclusion of shell-burning will render less sharp any test of the existence of the universal Fermi interaction based on a comparison of the observed and computed evolution times of the nuclei of planetary nebulae. The results suggest that the planetary nebula phase of a star's evolution may occur between helium-burning and carbon-burning, rather than directly before the white dwarf stage. (auth) (UK)

43827 INTERMEDIATE COUPLING LINE STRENGTHS IN THE $2p^2$–2p3s ARRAYS OF CI, NII, OIII. Tatum, J. B. (Radley Coll., Abingdon, Eng.). Mon. Notic. Roy. Astron. Soc., 140: 87-91(1968).

Line strengths and transition probabilities of all the lines in the $2p^2$–2p3s arrays of CI, NII, OIII, some of which are present in the xuv region of the solar chromospheric spectrum, are calculated using intermediate-coupling theory. (auth) (UK)

43828 ON THE FORMATION OF GRAPHITE PARTICLES IN THE ATMOSPHERES OF MIRA VARIABLES. Wickramasinghe, N. C. (Inst. of Theoretical Astronomy, Cambridge, Eng.). Mon. Notic. Roy. Astron. Soc., 140: 273-80(1968).

The observed molecular abundance ratios H_2O/H_2, CO/H_2, CN/H_2 in α-Orionis are explained on the basis of an equilibrium composition of the elements with atomic ratios $O/H \cong 10^{-4}$, $O/C \cong 1.03$, $N/C \cong 0.1$, and a total hydrogen density $\sim 6.10^{15}$ cm^{-3}. Provided that $O/C < 1.07$, $N/C < 1.0$, and the total hydrogen density exceeds $\sim 10^{13}$ cm^{-3}, it is shown that the free carbon in an M star atmosphere becomes saturated with respect to bulk graphite at $T \cong 1800$°K. About 0.1 to 1% of the total atmospheric carbon may condense into graphite flakes of radii $\sim 10^{-6}$ cm. (auth) (UK)

43829 EXCITATION TEMPERATURES OF THE WOLF–RAYET STARS. Bappu, M. K. V.; Ganesh, K. S. (Kodaikanal Observatory, India). Mon. Notic. Roy. Astron. Soc., 140: 71-9 (1968).

Hydrogenic transitions of CIV are used to derive excitation temperatures for Wolf–Rayet stars of the WC sequence. The line intensities of such transitions in HD 165763, HD 192641, HD 192103, and HD 184738 are derived from measures of equivalent widths on spectra of 10 Å/mm and 20 Å/mm dispersion. These intensities are corrected for continuum values derived by the method of photoelectric spectrophotometry. This technique of temperature determination yields values of temperature unaffected by non-LTE effects in the Wolf–Rayet atmosphere. The mean values obtained are as follows: HD 165763 (WC6) 56,900° ± 2600°; HD 192641 (WC7) 51,600° ± 6300°; HD 192103 (WC7) 37,300° ± 3400°; HD 184738 (WC8) 24,000° ± 4100°K. The intensities of the (4n) series of HeII are used to derive an excitation temperature of the WN7 star HD 192163, using intensities measured on a single high dispersion Mount Wilson coudé spectrogram. The value derived is 32,400° ± 4200°. A Balmer contribution to the emission of the Pickering series is obvious, though the hydrogen emission present is little. Arguments are presented to show that the (5–9) transition 8236 Å and the (5–15) transition 6406 Å can be utilized on high-dispersion spectra for obtaining reliable excitation temperatures of stars of the WN sequence. (auth) (UK)

43830 LOW NOISE SOLAR AND LABORATORY SPECTROSCOPY. III. THE Pb I 7229 A LINE AND THE SOLAR LEAD ABUNDANCE. Peach, J. V. (Oxford Univ.). Mon. Notic. Roy. Astron. Soc., 140: 43-51(1968).

An equivalent width of 0.29 ± 0.04 mÅ was found for the line of Pb I at 7229 Å from low noise spectra over a wide range of zenith distances. It is shown that a revision of the absolute oscillator strength scale for the solar Pb I lines on the basis of recently published measurements can remove the discrepancy between the value of the lead abundance based on this line and that based on the ultraviolet lines. An abundance $\log (N_{Pb}/N_H) = 1.93$ is derived on the scale of $\log (N_H) = 12.00$. (auth) (UK)

43831 ABUNDANCES OF SODIUM, MAGNESIUM, AND CALCIUM IN K-TYPE GIANT STARS. Peat, D. W.; Pemberton, A. C. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc., 140: 21-41(1968).

Narrow band photometric measures of the strengths of the magnesium b, calcium triplet, and sodium D lines in 312 G and K type giant stars were analysed with a model atmosphere technique to determine abundances of magnesium, calcium, and sodium. The following conclusions were reached: (1) [Mg/H], [Ca/H], [Na/H] in low-velocity stars do not differ significantly from their solar values. (2) High velocity stars are deficient in Ca and Na by varying amounts, but the mean ratio [Ca/Na] is approximately equal to its solar value. (3) Ultraviolet excesses show some correlation with [Ca/H] and [Na/H]. (4) [Mg/H] in high velocity stars is equal to or perhaps slightly greater than its solar value. (5) Almost all high velocity stars have [Mg/Ca] and [Mg/Na] greater than their solar values. The cutoff at the solar value is very abrupt. These results suggest that the magnesium content of the Galaxy increased at a more rapid rate than the calcium, sodium, and heavy element contents, and that it reached its present value at an earlier stage. The formation of high velocity giant stars must have come to an abrupt end at a particular instant in the history of the Galaxy. (auth) (UK)

43832 THE ABUNDANCES OF THE ELEMENTS IN THE SOLAR PHOTOSPHERE. VI. RUBIDIUM. Lambert, D. L.; Mallia, E. A. (Oxford Univ.). Mon. Notic. Roy. Astron. Soc., 140: 13-20(1968).

Low noise photoelectric scans of the Rb I resonance lines (λλ 7800 and 7947) were obtained with the Oxford spectrometer. An analysis results in an improved abundance determination, log N(Rb) = 2.63 on the standard scale where log N(H) = 12.00. (auth) (UK)

43833 THE MASSES OF SPECTROSCOPIC BINARY STARS IN THE SIXTH CATALOGUE. Batten, Alan H. (Dominion Astrophysical Observatory, Victoria, British Columbia); Ovenden, Michael W. Mon. Notic. Roy. Astron. Soc., 140: 81-5(1968).

Masses ($\mathcal{M}$) were computed for those spectroscopic binary stars in the Sixth Catalogue for which inclinations can be found from visual or eclipsing orbits, and for which absolute magnitudes can be found from visual orbits, trigonometric parallaxes or Hγ measurements. For absolute visual magnitudes $-6 < M_v < +2$, the M_v, log $\mathcal{M}$) relationship is linear, with no systematic differences between the Hγ magnitudes and the dynamical and trigonometrical magnitudes. For $M_v > +4$, there is slight evidence for a dual (M_v, log $\mathcal{M}$) relationship. The observed (M_{bol}, log $\mathcal{M}$) relationship is in good agreement with a series of main-sequence models with (X, Y) = (0.68, 0.30). (auth) (UK)

43834 EFFECT OF CENTRAL CONDENSATION ON THE PULSATION CHARACTERISTICS. Singh, Manmohan (Univ. of Roorkee, India). Mon. Notic. Roy. Astron. Soc., 140: 235-40 (1968).

The adiabatic radial oscillations of a number of composite polytropes were considered. It is shown that the ratio of mean and central density is not sufficient to characterize the pulsation characteristics, but the second moment of mass concentration is sufficient. (auth) (UK)

43835 EFFECT OF THE CONVECTION ZONE ON SOLAR SPIN-DOWN. Bretherton, F. P. (Cambridge Univ., Mass.); Spiegel, E. A. Astrophys. J., 153: L77-80(Aug. 1968).

A gradual reduction in the rotation of the solar surface layers induces a slow circulation in the convection zone. This circulation pumps fluid into the interior and gives rise to spin-down currents which are much more intense than those resulting from a solar Ekman layer. The process is calculated here with a simple model representing the convection zone by a porous medium and neglecting density stratification. (auth)

43836 TURBULENT SHEAR STRESS FROM DIFFERENTIAL ROTATION INSTABILITY. Colgate, Stirling A. (New Mexico Inst. of Mining and Tech., Socorro). Astrophys. J., 153: L81-3(Aug. 1968).

The turbulent shear stress associated with the new differential-rotation instability of Goldreich and Schubert is evaluated from elementary considerations of the momentum transport of the largest-size eddy. This instability occurs because the usual isentropic constraint is relaxed by thermal diffusivity. The resulting time for angular momentum to exchange within the star is the Kelvin–Helmholtz contraction time. This time is long enough so that a small (10^{-3}) stratification in molecular weight can develop leading to a small, stable differential rotation of the Sun. (auth)

43837 ON THE SPECTRUM OF BIDELMAN'S HELIUM VARIABLE STAR HD 125823. Jaschek, C. (Univ. Nacional de La Plata); Jaschek, M.; Morgan, W. W.; Slettebak, Arne. Astrophys. J., 153: L87-90(Aug. 1968).

The variations in the spectrum of HD 125823 can be represented by an oscillation between MK types B2 V and B7 IV on low-dispersion slit spectrograms. On spectrograms of higher dispersion, lines of both SiIII and SiII are present and are sensibly unchanged in intensity throughout the variations. The spectral type determined from the ratio of SiIII to SiII is B2. The star's "normal" state appears to be B2 V. At intervals the HeI lines become much weaker, without an accompanying change in the general level of excitation in the spectrum. At the helium-weak phase the spectrum may resemble the category of "weak helium-line" stars noted by Sharpless in Orion and discussed further by Sargent and Searle. (auth)

43838 TWO K DWARFS WITH ENHANCED BANDS OF MOLECULAR CARBON. Greenstein, Jesse L.; Oinas, Valdar (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Astrophys. J., 153: L91-3(Aug. 1968).

The strong-metallic-line stars ρ^1 Cancri and HD 145675 are found to contain enhanced CN and C_2, and to a lesser extent CH. Comparison with Schadee's models yields $C/O \approx 1$. The spectral type of both stars is around K0 V or K1 V, somewhat earlier than the metal lines would indicate. Absolute magnitudes derived from parallax data place both stars on or slightly above the main sequence. (auth)

43839 A COMPARISON OF THE X-RAY SPECTRA FROM TAU XR-1 AND THE VICINITY OF SGR XR-1. Riegler, Guenter R. (Univ. of Maryland, College Park); Boldt, Elihu; Serlemitsos, Peter. Astrophys. J., 153: L95-9(Aug. 1968).

Observations on hard x rays coming from the vicinity of Sgr X-1 and Tau X-1 are reported. The results are based upon data collected during two balloon flights. The method of scanning the sky and the detectors were the same for both experiments. (W.D.M.)

43840 SCATTER-HOLE CAMERAS FOR X-RAYS AND GAMMA RAYS. Dicke, R. H. (Princeton Univ., N. J.). Astrophys. J., 153: L101-6(Aug. 1968).

A pinhole camera for which the entrance area, covered with a very large number of randomly distributed pinholes, is 50% open is shown to be a very effective way of forming images of a complex of x-ray stars. A simple statistical trick is used to reduce the multitudinous overlapping images to a single image. Less than forty detected photons are needed to form an image of a single star. (auth)

43841 REDSHIFTED LINE PROFILES FROM DIFFERENTIALLY EXPANDING ATMOSPHERES. Hummer, D. G. (Joint Inst. of Lab. Astrophysics, Boulder, Colo.); Rybicki, G. B. Astrophys. J., 153: L107-10(Aug. 1968).

Accurate numerical solutions of the non-LTE radiative-transfer problem with noncoherent scattering were obtained using a generalization of the Riccati method of Rybicki and Hummer (1967). Differential expansion in the direction of the observer is found to produce significantly red-shifted line profiles. (auth)

43842 RATIO OF TOTAL-TO-SELECTIVE ABSORPTION IN THE GALACTIC ANTICENTER DIRECTION. Fernie, J. D.; Hube, Joan O. (Univ. of Toronto, Ont.). Astrophys. J., 153: L111(Aug. 1968).

Johnson's suggestion that the value of $R = A_V/E_{B-V}$ is higher between galactic longitudes 100° and 230° than at other longitudes is tested by the galactic rotation of classical Cepheids. Results indicate that, in general, R is not significantly different in this particular longitude range compared with other longitudes. (auth)

43843 A POSSIBLE TEST FOR WAVELENGTH-INDEPENDENT INTERSTELLAR EXTINCTION. Gray, D. F. (Univ. of Western Ontario, London). Astrophys. J., 153: L113-15(Aug. 1968).

A method for measuring neutral interstellar extinction is suggested which is completely independent of other methods. (W.D.M.)

43844 ENERGY REQUIREMENTS AND MECHANISMS FOR OH GALACTIC MASERS. Holtz, James Z. (Univ. of California, Berkeley). Astrophys. J., 153: L117-21(Aug. 1968).

The observed characteristics of anomalously intense OH microwave emission from the Galaxy have been explained in terms of a maser action. Various means have been proposed to pump this maser. General energetic requirements which are applicable to any pumping mechanism are considered here. Applied to the ultraviolet-pumping model, they show that the more intense OH sources would require ultraviolet intensities comparable with that provided by a large number of O-type stars located within a few light-years of these sources and thus would make the explanation of the strong OH emission in terms of this mechanism seem unlikely. (auth)

43845 RADIO MAPS OF CASSIOPEIA A AND TAURUS A AT 35 GHz. Braun, L. D.; Yen, J. L. (Univ. of Toronto). Astrophys. J., 153: L123-5(Aug. 1968).

Cassiopeia A and Taurus A were observed at 35 GHz by utilizing the 46-m-diameter paraboloidal antenna at the Algonquin Radio Observatory, Lake Traverse, Ontario, Canada. The antenna beam width is 1′, significantly less than the size of the sources. As a result, considerable source detail is available and is presented in the form of contour maps. (auth)

43846 THE SCREENING OF REMOTE OBJECTS BY INTERVENING GALAXIES IN AN EDDINGTON–LEMAITRE UNIVERSE. Roeder, R. C.; Verreault, R. T. (Univ. of Toronto). Astrophys. J., 153: L127-8(Aug. 1968).

The probability function which gives the probability of the effect of screening of remote objects by intervening galaxies as a function of the red shift of the remote emitter was calculated. It is shown that the probability is $\sim 1/3$ for emitters with red shifts of ~ 2. (auth)

43847 AN INDICATION OF GAPS IN THE GIANT BRANCH OF THE GLOBULAR CLUSTER M15. Sandage, Allan; Katem, Basil; Kristian, Jerome (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Astrophys. J., 153: L129-33(Aug. 1968).

The color–magnitude diagram for all measurable stars brighter than $V = 17.0$ in M15 shows gaps along the giant branch, the most pronounced of which is $\Delta V = 0.9$ mag brighter than the horizontal branch. Less accurate diagrams of other clusters also appear to show this feature. Comparison of the known errors of measurement, $\sigma(B-V)$, with the observed residuals from the ridge line of the giant branch shows that the intrinsic width of this sequence for $V < 15.25$ is less than $\sigma(B-V) = \pm 0.01$ mag. This gives an upper limit for the variation of the radii of evolving giants as $\delta R/R \simeq \pm 0.02$ at a given luminosity in M15. (auth)

43848 RADIO AND OPTICAL OBSERVATIONS OF THE HERCULES CLUSTER OF GALAXIES. Carr, T. D.; Omer, G. C. Jr.; Lebo, G. R.; Davis, R. W. (Univ. of Florida, Gainesville). Astrophys. J., 153: L139-42(Aug. 1968).

Radio scans across the Hercules Cluster of galaxies (Abell 2151) were compared with optical counts of numbers of galaxies per unit solid angle. An unresolved radio source was found to occupy the same position, within the limits of measurement, as the optical center of the cluster. In addition, a broad region of emission approximately centered on the cluster was found at the lower frequencies. (auth)

43849 STUDY OF THE EXCITATION OF FORBIDDEN LINES IN THE PARTICULAR PHYSICAL CONDITIONS OF QUASARS. Mathez, Guy (Institut d'Astrophysique, Paris). Compt. Rend., Ser. A and B, 266: 1541-4(June 17, 1968). (In French).

Processes other than collisions are found to play a role in the excitation of forbidden lines in the spectra from quasars. Terms for the direct radiative excitation of forbidden lines (in order to account for large radiation densities) and terms for radiative and collisional coupling with higher discrete and continuous levels (in order to account for relatively strong values of the density and electron temperature) are added to the statistical equilibrium equations. A comparison is made of the solutions for the ion densities from the statistical equilibrium equations with and without the above added terms. (J.F.P.)

43850 PHOTOGRAPH OF JETS IN THE SOLAR CORONA WITH THE HELP OF STRATOSPHERIC BALLOONS. Dollfus, Audouin; Fort, Bernard; Morel, Claude (Observatoire de Paris-Meudon, Meudon, France). Compt. Rend., Ser. A and B, 266: 1537-40(June 17, 1968). (In French).

The photograph of the solar corona was obtained from a balloon flight at an altitude of 30,000 m on February 7, 1968, with the aid of a telescope diffusing 1000 times less light than the Lyot coronagraph. (tr-auth)

43851 PRELIMINARY OBSERVATIONS OF STRONG RADIO SOURCES WITH 1' FAN BEAM IN 3.75 GHz. Watanabe, Takashi (Kyoto Univ.). Mem. Fac. Sci., Kyoto Univ., Ser. Phys., Astrophys., Geophys., Chem., 32: No. 2, 123-6(Mar. 1968).

Preliminary observations of Tau A, Cas A, and Cyg A were made with 3.75-GHz multiple-element interferometer at the Research Inst. of Atmospherics in Toyokawa. Its half-power beam width is 1' × 120'. Half-power width of Tau-A is 3.5'. Apparent diameter of shell structure of Cas A is 3'. Two components of Cyg A have approximately equal flux density. (auth)

43852 PULSARS. Maran, Stephen P. (Kitt Peak National Observatory, Tucson, Ariz.); Cameron, A. G. W. Phys. Today, 21: No. 8, 41-9(Aug. 1968).

The discovery of pulsars is reviewed and the flurry of activity stimulated by the discovery is mentioned. Observations are discussed in terms of energy and distance, pulse amplitude variations, pulse shapes and polarization, and optical observations. Theoretical considerations are briefly mentioned. (W.D.M.)

Atomic and Molecular Physics

Refer also to abstracts 43097, 43167, 43168, 43827, 43849, 44442, 44453, 44537, 44564, and 44790.

43853 (AEC-tr-6937, pp 6-11) ENERGY SPECTRUM OF ELECTRONS IN POLYSTYRENE. Nakai, Yohta; Matsuda, Kohji; Takagaki, Torao; Kimura, Ki-ichi. Translated from Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 8: 5-9(1966-67).

An abstract of this paper, prepared from the original language, appeared as NSA 22: 8117. (TSS)

43854 (EUR-4037) DIFFUSIONE DI NEUTRONI LENTI E DINAMICA MOLECOLARE DELLO STATO LIQUIDO. (Slow-Neutron Scattering and Molecular Dynamics of the Liquid State). Ardente, V.; Nardelli, G. F.; Reatto, L. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). June 1968. Contracts 140-63-4 ISPI; 196-65-4 ISPI. 50p. (In Italian). Dep.

This report deals with the general theory of slow-neutron scattering from a liquid and its connection with the molecular dynamics of the liquid state. A review is given of various models that have been proposed for describing the behavior of classical liquids, in particular the scattering function $S\ (\varkappa,\omega)$ and the velocity self-correlation function; consideration is given both to the individual-particle aspects of molecular dynamics, which are significant as regards incoherent scattering, and to the collective aspects, which are significant for coherent scattering. Also discussed are the new data on molecular dynamics that have been deduced from computer experiments, and the results thus obtained for the velocity self-correlation function are used to effect a comparison, on the basis of the impeded translator model recently proposed by the authors, with the corresponding predictions. (auth)

43855 (IFA-FT-70) RETARDATION IN THE ELASTIC SCATTERING OF PHOTONS BY ATOMIC HYDROGEN. Gavrila, M.; Costescu, A. (Academia R. P. R., Bucharest. Institutul de Fizica Atomica). 1968. 26p. Dep.

The matrix element for the elastic scattering of photons by atomic hydrogen is evaluated analytically in closed form in the nonrelativistic case including retardation. The method of integration is similar to the one used previously by one of the authors for the dipole approximation. It is based on the possibility of expressing the matrix element in terms of the Green's function for the Coulomb field in momentum space, for which an integral representation derived by Schwinger and others is then used. Some integrations yield the matrix element in terms of essentially two hypergeometric functions of Appell's type F_1, with variables and parameters depending on the photon energy. A preliminary discussion of the result is given. (auth)

43856 (IPP-1/76) ELECTRON-IMPACT IONIZATION CROSS SECTIONS AND IONIZATION RATE COEFFICIENTS FOR ATOMS AND IONS FROM SCANDIUM TO ZINC. Lotz, W. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Feb. 1968. 40p. Dep.

Using the empirical formula recently proposed, electron-impact ionization cross sections for single ionization from the ground state are given for free atoms and for nearly all ionization stages from scandium ($Z = 21$) to zinc ($Z = 30$). For these species, ionization rate coefficients are given under the assumption of a Maxwellian distribution of the impacting electrons. Multiple ionization, lowering of ionization potential, or collision limit are not taken into account. (auth)

43857 (LA-3899) ELECTRON-ELECTRON INTERACTION FROM SINGLE-ELECTRON THEORY. Huebner, Walter F. (Los Alamos Scientific Lab., N. Mex.). Mar. 1968. Contract W-7405-eng-36. 63p. Dep. CFSTI.

Electron-electron Coulomb interaction energies are expressed in terms of relativistic one-electron orbitals. The $F^{(0)}$ Slater integrals are tabulated using hydrogenic Dirac wave functions for $Z = 1$, 30, 56, 74, and 92. The average electron-electron interaction energy, τ, is obtained and tabulated for the same values of Z, for electron configurations in j-j coupling, from relativistic $F^{(0)}$ and nonrelativistic $G^{(k)}$ integrals, with $k \leq 6$. Interpolation formulas are given to obtain τ at other values of Z. An approximate method is proposed for obtaining binding energies for the electrons in ions in their ground state, and for ions and neutral atoms in excited states, from known binding energy data of neutral atoms corrected by the electron-electron interaction energy. (auth)

43858 (NYO-3829-17) THEORY OF GAMMA-RAY CROSS SECTIONS. Pratt, R. H. (Pittsburgh Univ., Pa. Dept. of Physics). Nov. 1967. Contract AT(30-1)-3829. 18p. (CONF-671102-44). Dep. CFSTI.

From 15th Conference on Remote Systems Technology and Atom Fair, Chicago, Ill.

Theory of the interaction between gamma rays and isolated atoms is reviewed, indicating recent progress and discussing future prospects. The photoelectric effect, scattering, and pair production are discussed in detail. 26 references. (J.W.R.)

43859 (ORNL-TM-2257) SCATTERING OF THERMAL ELECTRONS BY POLAR MOLECULES. Christodoulides, A. A.; Christophorou, L. G. (Oak Ridge National Lab., Tenn.). Aug. 1968. Contract W-7405-eng-26. 69p. Dep. CFSTI.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

Mean scattering cross sections and drift velocity data for thermal electrons in thirty-one polar molecules in the pure form and four in mixtures with ethylene have been obtained and are discussed. The electric molecular dipole moment, μ, ranges from 0 to ~4.1 Debye units (D.u.). From an analysis of the experimental data the general conclusion is drawn that the point dipole Born approximation calculation of Altshuler (1957) is in better agreement with experiment than the exact calculation of Mittleman and von Holdt (1965). Further, the experimental cross sections are higher than those predicted by Altshuler for all $\mu \lesssim 2.4$ D.u. and smaller when $\mu \gtrsim 2.4$ D.u., while their behavior at and around the minimum dipole moment, μ_{min}, required to bind an electron is complicated. The overall dependence of the experimental cross sections on μ indicates the possible effect of the binding of an electron to a molecule (when $\mu > \mu_{min}$) and is consistent with the existence of a potential resonance as predicted by Takayanagi and Itikawa (1968). (auth)

43860 (ORO-2911-10) INTERACTION OF HEAVY keV IONS WITH GASES. Progress Report, June 1, 1967-May 31, 1968. Report No. EE-3930-105-68U. Boring, John W. (Virginia Univ., Charlottesville. Research Labs. for the Engineering Sciences). June 1968. Contract AT(40-1)-2911. 15p. Dep. CFSTI.

The experimental work was concerned with continuing the development of a method of measuring total ionization by heavy ions in gases, and with the initial measurements of differential cross sections for the scattering of ions in the keV energy range. The ionization studies were directed toward an investigation of gas mixtures in an effort to learn more about the ultimate distribution of the primary ion's energy, and the first cross section measurements were concentrated on the elastic scattering of light ions by argon atoms to investigate the interaction potential between the collision partners. Theoretical work is also described. (J.H.R.)

43861 (UCRL-71195) A REVIEW OF ELECTRON IONIZATION OF ATOMS WITH EMPHASIS ON THE CROSSED BEAM METHOD. McFarland, Robert H. (California Univ., Livermore. Lawrence Radiation Lab.). July 10, 1968. Contract W-7405-eng-48. 34p. (CONF-680709-1). Dep. CFSTI.

From Gordon Research Conference on High Temperature Chemistry, Crystal Mountain, Wash.

Two experimental methods are described for the study of ionization of atoms by electron impact: (1) Tate and Smith's electron beam method for cross section measurements for permanent gases; and (2) the crossed-beam method for ionization measurements on materials which are solid at room temperatures. The results of ionization cross section measurements done previously are also presented. (TSS)

43862 (UUIP-574) THE SPECTRUM OF O V. Bockasten, Kjell; Johansson, Bertil (Uppsala Univ. (Sweden). Inst. of Physics). Mar. 1968. 51p. Dep.

The spectrum of four times ionized oxygen, O V, was studied with a theta-pinch discharge as a light source. Measured were 126 lines on the wavelength region 340 to 7700 Å, 93 of them being new lines. From these new measurements and 31 additional lines in the region 172 to 287 Å, measured earlier, the whole energy-level system was recalculated. The singlet and triplet systems were connected by common hydrogen-like transitions and by three intercombination lines. The uncertainty between the triplet and singlet levels in O V as earlier reported was $x = -182.4$. The ionization limit was determined to 918 657 ± 4 K by applying the polarization formula to the hydrogen-like levels and by using the theoretically predicted value of the dipole polarizability. Calculated wavelengths are given for 66 lines in the region 124 to 286 Å, suitable as reference lines. (Swed)

43863 IMPULSE APPROXIMATION FOR EXCITATION OF ATOMIC HYDROGEN. Coleman, J. P. (Univ. of Durham, Eng.). J. Phys., B, 1: 567-74(July 1968).

Cross sections for the process $H^+ + H(1s) \rightarrow H^+ + H(2s)$ were calculated in the quantal impulse approximation for proton energies in the range 1 to 500 keV. It is shown that a peaking approximation previously used in the evaluation of impulse approximation matrix elements is invalid and greatly underestimates the true impulse approximation cross section for this process. (auth) (UK)

43864 EFFECTIVE BORN CROSS SECTION FOR EXCITATION OF ATOMS BY ELECTRONS. Vainshtein, L. A.; Sobelman, I. I. (Lebedev Inst. of Physics, Moscow). J. Quant. Spectrosc. Radiative Transfer, 8: 1491-1526(Aug. 1968). (In Russian).

A summary of formulae and tables is given to permit calculation of the rate of electronic excitation and de-excitation of atoms $\langle v\sigma \rangle$. The effective cross section and the parameter $\langle v\sigma \rangle$ are calculated for transitions without change of atomic spin by Born's method, and for intercombination transitions by the Born–Ochkur method. Bates' and Damgaard's approximation to Coulomb's atomic wave function was used. The theoretical results were approximated by simple equations of two variables. The parameters were found by the least squares method and are tabulated as functions of the effective principal quantum numbers of the initial and final states for the transitions s–s, s–p, s–d, p–p, p–d. (auth) (UK)

43865 CLASSICAL CROSS SECTIONS FOR THE ELECTRON IONIZATION OF THE DEGENERATE LEVELS OF THE EXCITED STATES OF ATOMIC HYDROGEN. Kingston, A. E. (Queen's Univ., Belfast). J. Phys., B, 1: 559-66(July 1968).

The classical theory of Gryziński (1959 and 1965) is used to obtain cross sections for the electron ionization of the degenerate levels of atomic hydrogen. The results are compared with the Born approximation cross sections and it is found that the agreement is good. As the principal quantum is increased the classical and quantal cross sections tend to one another at all values of the incident electron energy for all azimuthal quantum numbers. (auth) (UK)

43866 MEASUREMENTS OF CROSS SECTIONS FOR THE IONIZATION OF Mg^+ TO Mg^{2+} BY ELECTRON IMPACT. Martin, S. O.; Peart, B.; Dolder, K. T. (Univ. of Newcastle Upon Tyne, Eng.). J. Phys., B, 1: 537-42(July 1968).

Cross sections were measured for the reaction $Mg^+ + e \rightarrow Mg^{2+} + 2e$ for electron energies between threshold and 2000 eV; the errors are estimated to be less than ±10% for electron energies greater than 50 eV. The cross section σ attains a maximum value 4.85×10^{-17} cm^2 (±11%) at 35 eV and, when E is greater than 11, it obeys the law $\sigma E = 9.8 \times 10^{-16} \lg (0.216 E)$ cm^2, where E is the incident electron energy in units of the ionization energy of Mg^+ (15.03 eV). No irregularities in the ionization function were found, which could be attributed to autoionization. (auth) (UK)

43867 SHELL CORRECTIONS FOR K- AND L-ELECTRONS. Khandelwal, Govind S. (Old Dominion Coll., Norfolk, Va.). Contract AT(40-1)-2408. Nucl. Phys., A116: 97-111(1968). (ORO-2408-5).

Walske's asymptotic stopping power formulas for K- and L-shell electrons are extended to cover the entire periodic table. Extensive use is made of the various existing formulas in numerical calculations. (auth)

43868 DETERMINATION OF THE DEGREE OF IONIZATION OF BORON IN SILICON WHEN ALLOYED BY ION BOMBARDMENT. Zorin, E. I., Pavlov, P. V.; Tetel'baum, D. I.; Shutov, Yu. N. (Gorky Scientific Research Physical-Technical Inst., USSR). Fiz. Tekh. Poluprov., 1: 1260-1(1967). (In Russian).

This is a continuation of earlier work where it was shown that the dependence of the degree of ionization of an impurity on the concentration in a semiconductor can be determined by diffusion measurements. The present paper presents preliminary results of a determination of the degree of ionization of boron from the carrier distribution and the distribution of the impurity atoms in silicon doped by boron by ion bombardment. Etched and polished samples of n-type silicon were bombarded with 40-keV boron ions in an accelerator with a magnetic analyzer, at a temperature of 90°C. The irradiation dose was 100 μC/cm^2. The distribution of the ionized boron atoms in the irradiated layer was determined by gradual removal of layers. The carrier density was determined from resistivity measurements. The results show that both the carrier density and the number of penetrating boron ions have a maximum at approximately the same depth below the surface of the sample. The degree of ionization was calculated from the formulas of the earlier paper and was shown to decrease with increasing acceptor concentration. The experimental results were in good agreement with the theoretical deduction of the earlier paper, as well as with results obtained by others. A slight decrease in the carrier density compared with the calculated profile might be due to incomplete ionization of the impurity. It is concluded that the distribution profiles of the impurity introduced into the semiconductor by ion bombardment can be used to investigate the dependence of the degree of ionization of the impurity on the concentration and to determine the degeneracy factor of the ground state of the impurity atom. (ATD)

43869 THE MEASUREMENT OF THE RATE OF RECOMBINATION OF HYDROGEN ATOMS AT ROOM TEMPERATURE BY MEANS OF esr SPECTROSCOPY. Bennett, J. E.; Blackmore, D. R. (Thornton Research Centre, Chester, Eng.). Proc. Roy. Soc. (London), Ser. A, 305: 553-74(July 23, 1968).

Electron spin resonance spectroscopy was used to determine the absolute concentrations of hydrogen atoms in a gas-flow system at room temperature and at total pressures between 1 and 10 torr. The kinetics of the decay of hydrogen atoms in the presence of undissociated molecular hydrogen were extensively analyzed on the basis of a statistical treatment of errors for a model that includes first- and second-order decay processes and axial diffusion of the atoms. Care was taken to consider the effects of high (up to about 20%) dissociation of hydrogen, of viscous pressure drop along the reaction tube, and of other possible decay processes. The predominant removal of hydrogen atoms was by the reaction $H + H + H_2 \xrightarrow{k_2} H_2 + H_2$, and the value of k_2 was $2.7 \pm 0.4 \times 10^{15}$ cm^6 mole^{-2} sec^{-1}. A small contribution from a first-order reaction $H \xrightarrow{k_1} \frac{1}{2} H_2$ (presumably a wall reaction) was also found. The rate constant, k_1, was 0.21 ± 0.15 sec^{-1}, which corresponds, in the case of a wall process, to a wall efficiency of $6.5 \pm 4.6 \times 10^{-7}$. No evidence could be found for the presence of the third-order process $H + H + H \xrightarrow{k_3} H_2 + H$, and an upper limit for k_3 could therefore be set at 5.0×10^{15} cm^6 mole^{-2} sec^{-1}. (auth) (UK)

43870 HYPERFINE STRUCTURE IN THE ^{253}Es EMISSION SPECTRUM. Worden, Earl F. (Univ. of California, Livermore); Gutmacher, Ralph G.; Lougheed, Ronald W.; Evans, James E.; Conway, John G. Contract W-7405-eng-48. J. Opt. Soc. Amer., 58: 998-1000(July 1968). (UCRL-70677).

The hyperfine structure was observed from six ^{253}Es emission lines photographed at high resolution. One line (3498 Å) showed well-resolved hfs, three showed partially resolved hfs, and two were unresolved patterns. The 3498 Å line is a flag pattern with eight resolved components. Arguments are given which favor the number of components in the line being I or spin limited rather than J limited. (TSS)

43871 CHEMICAL EFFECTS ON CORE-ELECTRON BINDING ENERGIES IN IODINE AND EUROPIUM. Fadley, C. S.; Hagstrom, S. B. M.; Klein, M. P.; Shirley, D. A. (Univ. of California, Berkeley). Contract W-7405-eng-48. J. Chem. Phys., 48: 3779-94(Apr. 15, 1968). (UCRL-17005).

A theoretical and experimental study was made of the shift in atomic core-electron binding energies caused by the chemical environment. Two models are presented to account for these "chemical shifts." The first uses an energy cycle to break the core-electron binding energies into a free-ion contribution and a classical Madelung energy contribution. The Madelung energy contributes a significant part of the binding-energy shift. It can, in principle, be evaluated rigorously although there is some ambiguity as to a surface correction. The reference level for binding energies must also be considered in comparing theory with experiment (or in comparing experimental shifts with one another). Electronic relaxation could also introduce errors of ~1 eV in shift measurements. The second, more approximate, model consists of a "charged-shell" approximation for bonding electrons in atomic complexes. It gives semiquantitative estimates of shifts and demonstrates the relationship between bond polarity and core-electron binding-energy shifts. These models indicate that several features of the free-ion state will be reflected also in chemical shifts. Free-ion Hartree–Fock calculations were made on F, Cl, Br, I, and Eu in several oxidation states. These indicate that the removal of a valence electron shifts the binding energies of all core levels by nearly equal amounts (10 to 20 eV). This shift decreases with increasing atomic number in a given chemical family. The removal of an inner "valence" electron (e.g., 4f in europium) gives rise to relatively large shifts (~20 eV). These features were also found in the experimental chemical shifts. Chemical shifts were measured for iodine in KI, KIO_3, and KIO_4 and for europium in $EuAl_2$ and Eu_2O_3, using the technique of photoelectron spectroscopy. Binding energies in iodine were found to increase by ~0.8 eV per unit increase in oxidation number. A Madelung energy calculation indicates that this corresponds to a loss of ~0.5 electronic charges from the valence shell per unit increase in oxidation state, and this value agrees approximately with previous results obtained from Moessbauer measurements. A shift of 10 eV was found between Eu^{2+} and Eu^{3+}. This very large shift is due largely to the loss of a full 4f electron in this change of oxidation state. With some refinements, the above technique could produce very useful information about bonding in ionic solids, in particular, allowing the determination of the charge on each atom. Their application to such problems as a determination of the oxidation states of metals in biological molecules seems even more promising. (auth)

43872 HYPERFINE SPLITTING OF THE INTERACTION ENERGY IN H + D AND IN D + D. Milleur, Mac B.; Curtiss, Larry A.; Twerdochlib, Michael; Hirschfelder, Joseph O. (Univ. of Wisconsin, Madison). J. Chem. Phys., 48: 4261-5(May 1, 1968).

The hyperfine interaction of a ground-state D atom with either a ground-state H or a ground-state D atom is treated. For H + D there are 24 hyperfine states with 12 potential-energy curves, and for D + D there are 36 hyperfine states with 22 potential-energy curves. At separations greater than $9a_0$ to $10a_0$, the electronic spins (for most of these hyperfine states) become partially decoupled and one can no longer refer to the molecule as being an electronic singlet or an electronic triplet. (auth)

43873 OPTICAL EXCITATION BY CHARGE EXCHANGE OF RARE GAS IONS FOR COLLISION ENERGY FROM 5 TO 300 eV. Schlumbohm, H. (Univ., Hamburg). Z. Naturforsch., 23a: 970-8(July 1968). (In German).

Measurements of the photoemission caused by collisons of ground-level He^+ and Ne^+ ions with Ar and Kr atoms have shown several multiplets of Ar(II) and Kr(II) within the investigated wavelength range of 3500 to 5500 Å. The charge-transfer processes into excited states of Ar^+ and Kr^+ occur at a high rate. The reactions are endothermic with a deficit of internal energy between 6 and 19 eV. The cross sections measured for several chosen transitions start at characteristic threshold energies between 10 and 25 eV. Above the threshold the cross sections rise slowly with increasing energy when Ne^+ is the colliding ion and very fast for He^+. Above 50 to 100 eV the cross sections show nearly constant values. The minimum kinetic energy values that can just fill up the deficits of internal energy are calculated and are shown to be equal to the measured threshold energies. Thus it follows that the pseudocrossing of the potential energy curves of the quasi molecules occurs at an energy value equal to the asymptotic level of the above curve. (auth)

43874 EXPERIMENTAL INVESTIGATION OF THE DOPPLER EFFECT AT THE ELECTRON CYCLOTRON FREQUENCY. Ivanov, B. I. (Physical-Technical Inst. of Low Temperatures, Kharkov). Zh. Eksp. Teor. Fiz., 55: 43-52(July 1968). (In Russian).

The Doppler shift of the electron gyrofrequency is studied experimentally. The measurements are carried out with an electron beam moving along the axis of a multimode resonator in the 10-cm range. A nonrelativistic as well as relativistic Doppler shift of the electron cyclotron frequency ω_c is detected. The possibility of applying the Doppler effect at ω_c in an investigation of the electron velocity distribution function is discussed. (auth)

43875 LITHIUM ION EMITTER FOR LOW ENERGY BEAM EXPERIMENTS. Heinz, O. (Naval Postgraduate School, Monterey, Calif.); Reaves, R. T. Rev. Sci. Instrum., 39: 1229-30 (Aug. 1968).

A system for producing low-energy lithium ions ($E \leq 100$ ev) is described. The emitter works on the principle that crystalline compounds such as $Li_2O \cdot Al_2O_3 \cdot 2SiO_2$ and $Li_2O \cdot Al_2O_3 \cdot 4SiO_2$ will emit lithium ions when heated above 1000°C. (W.H.K.)

43876 PYROELECTRIC CERAMICS AS DETECTORS OF FAST ATOMIC BEAMS. Berkner, Klaus H.; Myers, Booth R.; Pyle, Robert V. (Univ. of California, Berkeley). Rev. Sci. Instrum., 39: 1204-6(Aug. 1968).

A method for detecting fluxes of energetic atoms with pyroelectric ceramics is described. The detector consists of a commercially available, polarized lead zirconate–lead titanate (or barium titanate) disk which is silvered on both sides to provide electrical contact. The atoms are stopped in one of the silvered surfaces, and the resulting change in temperature gives rise to a pyroelectric signal. The atomic beam is chopped, and the signal-to-noise ratio is increased by phase-sensitive amplification in the system described. Detectors described have been calibrated from 1.6×10^{-7} to 3×10^{-1} W, and are remarkably linear over this range. (auth)

43877 MICROWAVE DISCHARGE SOURCE FOR ATOMIC AND MOLECULAR BEAM PRODUCTION. Brink, Gilbert O. (Cornell Aeronautical Lab., Buffalo); Fluegge, Robert A.; Hull, Robert J. Rev. Sci. Instrum., 39: 1171-2(Aug. 1968).

An atomic and molecular beam source is described which overcomes disadvantages present in earlier types of microwave discharge sources. The source uses a resonant coaxial line which requires no tuning adjustments inside the vacuum system. No water cooling is required. The source operates efficiently over a wide discharge pressure range and for many different discharge gases. (auth)

43878 INELASTIC SCATTERING OF ELECTRONS: CORRECTIONS TO THE MORSE AND BETHE FORMULAS. Tavard, Claude (Univ. of Indiana, Bloomington. Centre de Mecanique Ondulatoire Appliquee, Paris). Compt. Rend., Ser. A and B, 267: 91-4(July 8, 1968). (In French).

The calculation of the incoherent scattering of x rays and corrections to the formula of Waller and Hartree were previously explained. A similar treatment can be applied to the case of inelastic scattering of electrons by molecules. The essential steps of this treatment are set forth. The results obtained are compared to the formulas of Morse and Bethe in an application to the hydrogen atom. (tr-auth)

43879 ELASTIC SCATTERING OF SLOW ELECTRONS BY LITHIUM AND THE Be^+ ION. Feautrier, Nicole; Vo Ky Lan (Observatoire de Paris-Meudon, Meudon, France). Compt. Rend., Ser. A and B, 267: 124-7(July 8, 1968). (In French).

The Stone theory of polarized orbitals is used to study the elastic scattering of electrons by lithium and Be^+ ions. The deformation of the atomic orbitals due to the presence of the incident electron assumed stationary is studied first, then the potential by which the electron is scattered is calculated. The results of the methods of close coupling and polarized orbitals are shown and compared for electron scattering by lithium, and the phase shifts calculated by the polarized orbital method are shown for beryllium ions. It is found that the method of polarized orbitals gives, by much shorter calculations, the same results obtainable by the method of close coupling. (J.F.P.)

43880 INAPPLICABILITY OF THE BORN EXCHANGE SCATTERING AMPLITUDE FOR THE He ($1^1S \rightarrow 2^3S$) TRANSITION. Miller, Kenneth J.; Krauss, Morris (National Bureau of Standards, Washington, D. C.). Contract AT(49-2)-1165. J. Chem. Phys., 48: 2611-14(Mar. 15, 1968).

Differential cross sections are calculated for the He ($1^1S \rightarrow 2^3S$) transition within the Born–Oppenheimer approximation. The Bonham – Ochkur (OB) approximation is compared to the exact exchange scattering amplitude and it is found to yield semiquantitative agreement, especially at high incident energies. However, the theoretical results show qualitatively different behavior from recent experimental results. Experimental differential cross sections peak in the forward direction while theory predicts a maximum at large angles. (auth)

43881 HIGH-RESOLUTION STUDY OF ELECTRON-IMPACT SPECTRA AT KINETIC ENERGIES BETWEEN 33 AND 100 eV AND SCATTERING ANGLES TO 16°. Lassettre, Edwin N.; Skerbele, Ausma; Dillon, Michael A.; Ross, Kevin J. (Carnegie-Mellon Univ., Pittsburgh). J. Chem. Phys., 48: 5066-96(June 1, 1968).

An electrostatic lens system that compensates for chromatic aberration has been tested in an electron spectrometer. The results indicate that this lens is suitable for comparisons of peak intensities in electron-impact spectra. Relative intensities in vibrational progressions that belong to a single electronic transition have been studied in N_2, CO, and NH_3 and found to be nearly independent of the scattering angle. Electron-impact spectra have been reported for helium, nitrogen, oxygen, argon, nitric oxide, nitrous oxide, ammonia, water vapor, carbon dioxide, ethylene, acetylene, and benzene at electron kinetic energies between 33 and 100 eV. Spectral regions of special interest are encountered in CO_2 and C_6H_6. At excitation energies of 7 to 10 eV in CO_2 a change in intensity distribution, attributed to transition from an electric-quadrupole to an electric-dipole spectrum, is observed as the kinetic energy is raised. In the case of C_6H_6 a change in the spectrum with angle is encountered, which strongly suggests that two electronic transitions occur in a spectral region thought previously to contain only one. (auth)

43882 ELASTIC SCATTERING OF ELECTRONS BY ATOMIC HYDROGEN. Jha, R.; Sil, N. C. (Indian Association for the Cultivation of Science, Calcutta). Indian J. Phys., 41: 875-81 (Dec. 1967).

The variational method of Hulthén (1944) has been used to calculate the S-wave phase shifts in elastic scattering of electrons by atomic hydrogen in the energy range of 0 to 13.6 eV, by solving the integro-differential equation of Temkin and Lamkin (1961) in the adiabatic exchange approximation. Calculations were also performed for the polarization potential of Obédkov (1963). (auth)

43883 ELASTIC SCATTERING OF ELECTRONS BY HELIUM ATOMS. Jha, R.; Banerjee, S. N.; Sil, N. C. (Indian Association for the Cultivation of Science, Calcutta). Indian J. Phys., 41: 891-6(Dec. 1967).

The S-wave phase shifts (η_0) in the elastic $\bar{e}$-He collision problem have been computed by Hulthén's variational method in the energy range of 5 to 54.4 eV. The total wave function of the helium atom and electron system has been expanded in such a way as to include virtual excitation to 2^1S and 2^3S states. Our results for S-wave partial cross sections have been compared with the theoretical findings of Marriott (1963), LaBahn and Callaway (1964), Moiseiwitsch (1953), and Zhikhareva (1965) and with the experimental results of Golden and Bandel (1965) and Ramsauer and Kollath (1929, 1932). (auth)

43884 INVESTIGATION BY THE COINCIDENCE METHOD OF CHARGE STATE CHANGES OCCURRING IN THE INTERACTION BETWEEN H^+, H^0, AND H^- AND THE XENON ATOM. Afrosimov, V. V.; Mamaev, Yu. A.; Panov, M. N.; Fedorenko, N. V. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz., 55: 97-110(July 1968). (In Russian).

The cross sections for elementary processes of charge-state changes involved in the interaction between hydrogen atoms or negative ions and xenon atoms are measured by simultaneous analysis of the charge state of the two atomic particles participating in the collision and coincidence recording of the particles. The cross sections for processes leading to formation of xenon ions with charges between 1 and 4 and of fast hydrogen particles in charge states +1, 0, −1 are measured with energies of the H^0 atoms and H^- ions ranging from 5 to 50 keV. The cross sections for these elementary processes of charge-state variation for hydrogen atoms and negative ions are compared with the cross sections for similar processes involving protons measured by the coincidence method in previous work in the same energy range. It is found that the proton cross sections for xenon-ion formation of various charge values are greater than the same cross sections for H^0 atoms or H^- ions. This is partly due to electron capture by protons with simultaneous ionziation of the Xe atom and partly to the large value of the proton cross sections for pure ionization of the Xe atom. The largest contribution to formation of xenon ions of arbitrary charge in collisions between Xe atoms and H^+, H^0, of H^- comes from those elementary processes that lead to the formation of fast H^0 atoms, irrespective of the initial charge state of the fast particles. Proton-formation elementary processes give a smaller contribution, and H^--ion formation an insignificant contribution. The probability distribution of various finite charge states of fast hydrogen particles (+1, 0, and −1) in single collisions involving the formation of xenon ions weakly depends on the initial charge state of the xenon ions. This permits one to conditionally divide the collision between a light hydrogen particle and multi-electron atom into two stages. In the first, when the nuclear particles approach each other, the target atom is excited and subsequently autoionization transitions and formation of a slow ion occurs. In the second stage, when the particles fly apart, the interaction between the fast particle and weakly bound external electrons of the atom results in a probability distribution of the finite charge states determined by the velocity of the fast particle but only weakly dependent on its initial charge state and total excitation energy of the atom. (auth)

43885 IONIZATION OF ALKALI METAL ATOMS BY SLOW ELECTRONS. Zapesochnyi, I. P.; Aleksakhin, I. S. Zh. Eksp. Teor. Fiz., 55: 76-85(July 1968). (In Russian).

An improved technique for studying ionization in intersecting atomic and monoenergetic electron beams is described. The effective ionization cross sections for all alkali metals are measured for electron energies ranging from the threshold up to 30 eV. A linear law of growth of the cross sections near the ionization threshold predicted by the Geltman theory is observed and the ranges of linearity for each atom are determined. The complex structure observed on the cesium, rubidium, and potassium ionization curves can be consistently and uniquely explained by excitation of the alkali atom p electron and its subsequent ionization (with removal of the p electron). (auth)

43886 STARK BROADENING OF THE LYMAN ALPHA LINE. I. Ishimura, Tsutomu (Osaka Univ.). Kakuyugo-Kenkyu, 19: No. 2, 95-169(July 1967). (In Japanese).

Wave functions of a hydrogen atom are obtained under such an assumption that the hydrogen atom is perturbed successively by moving ions in a plasma. Due to the thermal motion of ions, the perturbation field around the atom is a time-dependent one so that the wave functions of the atom have no corresponding energy eigenfunction. However, they are expressed by linear combinations of the eigenfunctions of an unperturbed atom; the wave functions throughout the lifetime of the energy level of the atom are determined so as to satisfy the Schrödinger equation including the perturbation Hamiltonian. From these wave functions, the profile of the Lyman-alpha line emitted from a certain hydrogen atom is calculated. Using the result of this calculation, the line profile observed by experiment is obtained by a statistical treatment where the profile of the line emitted from a certain atom is averaged over all possible velocities of the perturbing ion and its closest distance to the atom. Because no restriction is imposed upon the range of the temperature and the ion density of the plasma, the obtained result is a most general one. In the one extreme case, where the temperature of the plasma is low and the ion density is high, the present theory gives results coincident with those of the quasi-static theory. In the other extreme case, that is, in the case of the plasma of high temperature and low ion density, the present theory shows that the line profile coincides with a Lorentzian one predicted by the impact theory. (TSS) (NSA of Japan)

43887 EFFECT OF LATTICE THERMAL OSCILLATIONS ON SCATTERING OF IONS BY CRYSTALS. Chicherov, V. M. Zh. Eksp. Teor. Fiz., 55: 25-38(July 1968). (In Russian).

Results are presented of an experimental investigation of the effect of the temperature of a copper single-crystal target on the energy and angular distributions of argon ions with initial energies of 10 to 20 keV scattered by the surface of the target. An oscillographic technique was employed, which ensured a high degree of constancy of external parameters (beam current, target temperature) during the recording time of each spectrum. This facilitated the experiments in a broad range of glancing and scattering angles, bombarding ion energies, and target temperatures. The effect of the target temperature on the angular distributions, width of the energy spectra, and dependence of the ratio of the peak intensities of singly and doubly scattered argon ions on the initial energy of the bombarding ions is detected and investigated. The investigations are performed for two different orientations of the ion beam relative to the crystallographic directions on the target surface. A result characteristic of both orientations is the much greater effect of the target temperature on scattering in the case when the glancing angle as well as the scattering angle is small and the decrease of the effect of the target temperature when the angles increase. (auth)

43888 RYDBERG STATES AND SCATTERING STATES OF MOLECULAR ELECTRONS: $e-H_2^+$. Berry, R. Stephen (Univ. of Chicago); Nielsen, Svend Erik J. Chem. Phys., 49: 116-21 (July 1, 1968).

A general method is presented for obtaining a model potential for calculation of Rydberg states and ionized states of an electron in a diatomic (or more complex) molecule. The potential is derived from a known wave function for the ionic molecule core by expanding the charge distribution, including the fixed-position nuclei, in spherical harmonics. Exchange effects are included in the form of an effective local $\rho^{1/3}$ potential. The method is applied to the Rydberg states of H_2 to examine the various contributions to the level splittings and the dependence of these on internuclear distance R. It is also applied to the determination of phase shifts in $e-H_2^+$ scattering and to the dependence of these phase shifts on R. The particular utility of the method is the ease and efficiency with which one can explore the behavior of electronic contributions to a wide variety of matrix elements, as functions of all the parameters n (or E), l, m, and R. (auth)

43889 QUANTUM DEFECT METHOD FOR LINEAR MOLECULES AND e–H_2^+ SCATTERING. Weinberg, Michael; Berry, R. Stephen; Tully, John C. (Univ. of Chicago). J. Chem. Phys., 49: 122-6(July 1, 1968).

The quantum defect method is extended to permit calculation of short-range phase shifts for electron scattering states in the field of a linear molecule–ion. The method is applied to the low-energy ($k < 0.2$ a.u.) scattering of electrons by H_2^+; the differential scattering cross section is calculated and compared with that derived by Temkin and Vasavada. (auth)

43890 ROLE OF THE ANISOTROPY OF THE POTENTIAL IN QUENCHING OF GLORY EXTREMA IN ATOM–DIATOMIC MOLECULE SCATTERING. Olson, R. E.; Bernstein, R. B. (Univ. of Wisconsin, Madison). J. Chem. Phys., 49: 162-71 (July 1, 1968).

Damping of the glory undulations in the velocity dependence of the total cross sections for atom–molecule scattering was first observed by Gislason and Kwei and (correctly) explained by them qualitatively in terms of inelastic and reactive processes concurrent with anisotropic elastic scattering. Subsequent experiments by Helbing and Rothe confirmed the quenching phenomenon and extended the range of systems exhibiting such behavior. The present theory deals mainly with nonreactive atom–diatomic collisions, considering the coupled equations in the total angular-momentum representation and taking full cognizance of the anisotropic distortion of the potential. The resulting equations yield a lower bound on the degree of quenching, but should be fairly generally applicable except for extremely reactive systems of the "stripping" type. The extent of the damping and its velocity dependence is expected to be increased for systems of larger reduced mass with deeper van der Waals potential wells (ϵ), larger-size parameters (r_m), and greater short-range anisotropy coefficients. The equations suggest a simple method to retrieve the short-range anisotropy coefficient of the potential from quenching data. (auth)

43891 COMPUTATIONAL INVESTIGATION OF INTERNAL EXCITATION IN NONREACTIVE MOLECULAR COLLISIONS: RESONANCES IN ROTATIONAL EXCITATION. Levine, R. D.; Johnson, B. R.; Muckerman, J. T.; Bernstein, R. B. (Univ. of Wisconsin, Madison). J. Chem. Phys., 49: 56-64(July 1, 1968).

Resonances in subexcitation molecular collisions are demonstrated by exact numerical solution of the close-coupled integral equations for rotational excitation including closed channels in the total-angular-momentum representation. These results serve as a reference for comparing various approximate theoretical predictions. In particular, the limitations of the adiabatic approximation are exhibited. The resonance energies can be essentially predicted by a "best local" potential approximation. The resonance line shapes are fitted by a simple Breit–Wigner form. (auth)

43892 INELASTIC MOLECULAR COLLISIONS: EXPONENTIAL SOLUTION OF COUPLED EQUATIONS FOR VIBRATION–TRANSLATION ENERGY TRANSFER. Chan, Sai-kit (Univ. of Chicago); Light, J. C.; Lin, Jeong-long J. Chem. Phys., 49: 86-97(July 1, 1968).

A new numerical method is used to solve the quantum-mechanical problem of energy transfer between vibrational and translational degrees of freedom in collisions between an oscillator and an atom. The dependence of the probability of vibrational excitation on the energy of the collision and the size of the truncated basis set are examined. The oscillatory dependence of this transition probability on the energy is shown to be an artifact due to the truncation of the basis set. The new numerical method is the stepwise solution of the coupled first order differential equations by exponentiation of the integrated coupling matrices, an application of the general method investigated by Magnus. It is shown to be fast and accurate. (auth)

43893 ROTATIONAL EXCITATION OF H_2 BY SLOW ELECTRONS IN A BEAM EXPERIMENT. Ehrhardt, H.; Linder, F. (Univ., Freiburg i. B.). Phys. Rev. Lett., 21: 419-21(Aug. 12, 1968).

Rotational excitation and de-excitation $J_f - J_i = \pm 2$, $J_i = 0, \ldots, 3$, of H_2 by slow electrons with and without the simultaneous excitation of one vibrational quantum have been measured. The absolute total cross section for pure rotational excitation $J = 3 \leftarrow 1$ in the energy range 1 to 10 eV is preserted. The measurements of angular dependences indicate s-, p-, and d-wave scattering. (auth)

43894 CALCULATION OF THE SPACE CHARGE POTENTIALS CREATED BY ELLIPTICAL BEAMS. Tanguy, Pierre (Faculte des Sciences, Rennes-Beaulieu, France). Compt. Rend., Ser. A and B, 266: 1202-5(Apr. 29, 1968). (In French).

The space charge potentials created by elliptical beams in which the density is not constant were calculated. The particular cases of parabolic and gaussian densities were examined. (tr-auth)

43895 THEORETICAL RESOLUTION CAPACITY OF A CYLINDRICAL ELECTROSTATIC ANALYZER AT 127° USED AS MONOCHROMATOR FOR SLOW IONS (10 TO 100 eV): EFFECT OF THE SPACE CHARGE. Francois, Robert; Barat, Michel (Faculte des Sciences, Orsay, France). Compt. Rend., Ser. A and B, 266: 1306-8(May 13, 1968). (In French).

The numerical resolution of the equation of trajectories in a cylindrical electrostatic analyzer at 127° taking into consideration the space charge effect made it possible to obtain an empirical expression for the energy resolution. The maximum ion current that can be obtained at the output of the monochromator when an energy dispersion ΔE is fixed *a priori* was deduced. (tr-auth)

43896 EQUIVALENCE BETWEEN A MAGNETIC LENS WITH PERIODIC LONGITUDINAL FIELD AND A HEXAPOLAR MAGNET FOR THE SEPARATION AND FOCUSING OF HYDROGEN ATOMS. Checkrahamatoula (Faculte des Sciences, Orsay, France). Compt. Rend., Ser. A and B, 266: 1309-12(May 13, 1968). (In French).

It is shown that a lens with periodic longitudinal magnetic field is equivalent to a hexapolar magnet with transverse field. This equivalence permits a simple analysis of its optical properties when it is associated with a hydrogen-atom source. (tr-auth)

43897 REEXAMINATION OF THE NUCLEAR ISOMER SHIFT AS MEASURED IN MUONIC ATOMS. Gal, A.; Grodzins, L.; Huefner, Joerg (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Lett., 21: 453-6(Aug. 12, 1968).

The magnetic hyperfine splitting for rotational levels of deformed, even–even nuclei in muonic atoms is shown to result in an asymmetric γ-ray doublet, whose center of gravity is in general shifted toward lower energies. This pseudoisomer shift is of the order of magnitude of the reported "isomer" shifts. (auth)

43898 ROLE OF INTERMEDIATE STATES IN THE EXCITATION OF ATOMS BY ELECTRON IMPACT. Vainshtein, L. A.; Presnyakov, L. P. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz., 55: 297-303(July 1968). (In Russian).

In a number of cases a calculation of the cross section for electron impact excitation of atoms in the first Born approximation leads to an error which is unusual for this approximation, viz. the cross section turns out to be smaller than the experimental value. A situation of this type arises when the probability for direct excitation is relatively small and an important role is played by the transition via a virtual level in second-order perturbation theory. An approximate formula for calculating the cross section in the second order is obtained. With allowance for a single virtual level the calculations for quadrupole transitions in He and Ne yield an error which is "typical" for the Born method. (auth)

43899 SCATTERING OF ELECTRONS BY DIATOMIC MOLECULES IN THE APPROXIMATION OF TWO SHORT-RANGE POTENTIALS. Subramanyan, R. (Leningrad State Univ.). Zh. Eksp. Teor. Fiz., 55: 363-8(July 1968). (In Russian).

The elastic scattering of electrons by diatomic molecules is considered in the approximation where the interaction potential of electrons with atoms is replaced by two-range potential wells. The scattering cross section is calculated in the case when the atoms are spinless as well as in the case when they have spin $\frac{1}{2}$. Results of the calculation are given for the concrete case of hydrogen molecules and they are compared with experiments. (auth)

43900 ATOMIC BEAM SOURCE FOR THE ENERGY RANGE OF 0.2 TO 45-eV. Politiek, J.; Rol, P. K.; Los, J.; Ikelaar, P. G. (FOM-Instituut voor Atoom-en Molecuulfysica, Amsterdam). Rev. Sci. Instrum., 39: 1147-50(Aug. 1968).

An apparatus has been developed for producing an atomic beam of potassium in the energy range of 0.2 to 45 eV (1000 to 15,000 m/sec). The technique used is cathode sputtering. With a velocity selector (spread, 6.7%; maximum rotational speed, 48,000 rpm), both the signal of a Pt–W detector and an energy-independent one are measured as a function of the velocity of the beam particles. (auth)

43901 INCOHERENT SCATTERING OF 1002-keV GAMMA RAYS BY K-SHELL ELECTRONS IN Sn, Sm, Ta, AND Pb. Reddy,

A. Ramalinga; Parthasaradhi, K.; Lakshiminarayana, V.; Jnananda, Swami (Andhra Univ., Waltair, India). Indian J. Pure Appl. Phys., 6: 255-6(May 1968).

Incoherent scattering of 1002-keV gamma rays by K-shell electrons is studied experimentally in Sn, Sm, Ta, and Pb at scattering angles 40, 60, 90, and 128°. Agreement is found within the range of errors between the experimental values and the theoretical values evaluated utilizing the expressions of J. M. Jauch and F. Rohrlich [The theory of photons and electrons, Addison-Wesley Publishing Co. Inc., Massachusetts, (1955)] at all angles and in all elements except at 40° in Ta and Pb. In these two elements at 40° agreement is observed within the range of errors between the experimental values and the theoretical values evaluated utilizing the expressions of Shimuzu et al. [Phys. Rev., 140: A806 (1965)], which are especially intended for low-momentum transfers. (auth)

43902 ADVANCED LEVEL ATOMIC PHYSICS. Mossop, G. M. London, University Press, 1968. 318p. 30s.

The subject is treated under the following main headings: atoms and subatomic particles (introduction and historical outline, electrons and cathode rays, applications of electron beams, subatomic particles and positive ions); the atom and its nucleus (properties of radioactivity, detectors of radiation, experiments with radioactive sources, applications of radioactivity, nuclear energy, fission, nuclear reactors, fusion); the atom and its electrons (the quantum theory, atomic structure: arrangement of electrons in the atom, properties governed by electron structure); further topics (accelerators and high-energy particles, further subatomic particles, particle–wave duality, lasers, semiconductors). (UK)

43903 SCATTERING CROSS-SECTIONS OF GAMMA RAYS IN COPPER. Parthasaradhi, K. (Andhra Univ., Waltair, India). Indian J. Pure Appl. Phys., 6: 254-5(May 1968).

Experimental gamma-ray scattering cross sections in copper at energies 40, 84, 129, 145, 279, 320, 411, and 662 keV have been determined by subtracting theoretically calculated exact total photoelectric cross sections of R. D. Schmickley and R. H. Pratt [Tables of calculated photoelectric cross sections for energies 10 to 3000 keV, Lockheed Missiles & Space Co. Inc. (1967)] from total experimental gamma-ray cross sections. It has been found that in the energy region 84 to 279 keV, scattering cross sections evaluated on the basis of the Thomas–Fermi model are overestimations. (auth)

43904 ATOM-FORMATION RATES BEHIND SHOCK WAVES IN HYDROGEN AND THE EFFECT OF ADDED OXYGEN. Myerson, A. L.; Watt, W. S. (Cornell Aeronautical Lab., Inc., Buffalo). J. Chem. Phys., 49: 425-33(July 1, 1968).

A direct isothermal measurement has been made of the rate of formation of atomic hydrogen behind shock waves in hydrogen–argon mixtures. This has been accomplished by using atomic resonance absorption spectrophotometry at the Lyman-α line of both ^{1}H and ^{2}H. The observations were made in an ultrahigh-purity shock tube. Absorption coefficients for the atoms were determined experimentally. The hydrogen–argon dissociation rate is given by the expression $k_{H_2-Ar} = 2.23 \times 10^{12}\ T^{1/2} \exp(-92,600/RT)$ cm^3 mole^{-1} · sec^{-1} over the temperature range 2290° to 3790°K. The hydrogen molecule was found to be five times more effective than argon as a collision partner. Because of the sensitivity of the technique, it was also possible to determine quantitatively the catalytic effect of the addition of small amounts of oxygen. From these observations an expression $k_{H-O_2} = 6.0 \times 10^{12}\ T^{1/2} \exp(-17,750/RT)$ cm^3 mole^{-1} · sec^{-1} was obtained for the reaction $H + O_2 = OH + O$ over the temperature range 1700° to 2700°K. (auth)

43905 THEORY OF THE IONIZATION OF ATOMS BY ELECTRON IMPACT. Rudge, M. R. H. (Queen's Univ., Belfast). Rev. Mod. Phys., 40: 564-89(July 1968).

A review of the quantum theory of ionizing collisions is presented, with particular regard to recent theoretical developments. A discussion is given of quantal and classical approximations and their predictions compared with experimental data. Some useful empirical formulas are listed and compared, and in conclusion mention is made of the present inadequacies in the theory. (auth)

43906 ENERGY EFFICIENCY OF LEAD SELF-SPUTTERING. Andersen, Hans Henrik (Atomic Energy Commission, Risoe, Denmark). Appl. Phys. Lett., 13: 85-6(Aug. 1, 1968).

The sputtering efficiency (i.e., ratio between sputtered energy and impinging ion energy) was measured for 30 to 75 keV lead ions impinging on polycrystalline lead. The results are in good agreement with recent theoretical estimates. (auth)

43907 POTASSIUM–ELECTRON ELASTIC SPIN EXCHANGE: COMPARISON OF EXPERIMENT WITH A CLOSE-COUPLING CALCULATION. Collins, R. E.; Bederson, B.; Goldstein, M.; Rubin, K. (New York Univ.). Phys. Lett., 27A: 440-1(Aug. 26, 1968).

Measurements are reported on the ratio of the differential exchange cross section to the full differential cross section for the elastic scattering of low-energy electrons by potassium, for angles between 15° and 180° and energies between 0.5 and 1.2 eV. (auth)

43908 THE WAVE MECHANICS OF ATOMS, MOLECULES, AND IONS. Schutte, C. J. H. London, Arnold, 1968. 516p. 84s.

The subject is treated under the following headings: principles of wave mechanics; wave mechanics of particles subjected to simple potential functions (particle in a box and its applications, the harmonic oscillator and its applications in spectroscopy, wave mechanics of rotating bodies, the hydrogen atom and its spectrum, polyelectronic atoms, formal group theory, group theory and wave mechanics, molecular-orbital theory; diatomic molecules, polyatomic molecules, systems with conjugated double bonds: Hückel's molecular orbital method); spectroscopy (principles, rotational spectroscopy, vibrational spectroscopy of polyatomic molecules and ions, spectroscopy of transition-metal ions, nuclear magnetic resonance spectroscopy). Appendixes include some properties of group representations, and physical constants and conversion factors. Some problems and answers are included. The book is intended as an introduction to the subject for chemistry students. (UK)

43909 CALCULATION OF POTENTIAL FUNCTIONS OF VARIOUS EXCITED SINGLET STATES OF MOLECULES H_2, HD, AND D_2. Monfils, A. (Univ., Liege). Bull. Cl. Sci., Acad. Roy. Belg., 54: 44-80(1968). (In French).

Using vibrational and rotational constants published in earlier papers, experimental potential curves have been determined by the Rydberg–Klein–Rees method for the $B^1\Sigma_u^+$, $B'^1\Sigma_u^+$, $B''^1\Sigma_u^+$, $C^1\Pi_u$, $D^1\Pi_u$, $D'^1\Pi_u$, and $D''^1\Pi_u$, states of molecules H_2, HD, and D_2. In the case of the Π states, the Π^- and Π^+ sub-states have been treated separately: it is shown that the corresponding curves are mutually displaced, while keeping the same shape for each state and molecule. An isotope effect has been detected: it consists in selective displacements of the outer turning points (R_{max}). Furthermore, these displacements of R_{max} have been found to be proportional to the differences between the reduced masses of the molecules. (auth)

43910 DETERMINATION OF ELECTRON DENSITY FROM EMISSION LINES OF THE BALMER SERIES. Kurochka, L. N. (Kiev Univ.). Astrophysics (Engl. Transl.), 1: 195-6(Oct.-Dec. 1965).

Translated from Astrofizika, 1: 369-72(1965).

Relationships between electron density, the last resolvable line, and the half-width of the observed lines are determined using the contours of lines broadened by ion and electron fields. (auth)

43911 A GENERALIZED THEORY FOR LINE FORMATION IN A HOMOGENEOUS MAGNETIC FIELD. Moe, Olav Kjeldseth (Univ. of Oslo). Solar Phys., 4: 267-85(July 1968).

The formation of spectral lines in a homogeneous magnetic field was studied. A new method for solving the transfer equations for polarized light was found. Using this method, the Stokes parameters may be derived without any special assumptions regarding the model atmosphere. With the line formed by pure absorption, the expressions for the Stokes parameters may easily be adapted to numerical calculations. In order to illustrate the method, the line profile for the Zeeman triplet λ5250 was calculated using a photospheric model atmosphere. (auth)

43912 VIBRATIONAL EXCITATION OF H_2-MOLECULES IN CENTRAL COLLISIONS WITH Li^+-IONS. Schoettler, J.; Toennies, J. P. (Univ., Bonn). Z. Phys., 214: 472-502(1968). (In German).

An apparatus is described for measuring the inelastic differential cross section for vibrational excitation in collisions of diatomic molecules with monoenergetic ions at laboratory energies between 10 and 50 eV. The method consists of measuring the time of flight of single ions with a time amplitude converter and displaying the results on a 100 channel pulse height analyzer. From the shift in the time of flight relative to that expected for elastic scattering the final state of the molecule excited in a single collision is identified. By studying only central collisions with almost zero impact parameter rotational excitation is strongly suppressed. Measured times of flight after collisions of monoenergetic Li^+ ions with H_2 show that with increasing energy the most probable vibrational quantum jump increases from 0 → 1 to 0 → 2, 0 → 3 etc. Contrary to the usual assumption of a small steric factor for vibrational excitation the results show that the inelastic cross section is larger than the elastic cross section. Using reported potential parameters the energy dependence of the most probable excited state is compared with the calculations of Secrest and Johnson for a one-dimensional collinear collision. The satisfactory agreement suggests that the steric factor is close to 1. From measurements at different scattering angles at 10 eV the integral inelastic cross section is found to be about 0.2 Å^2 corresponding to a differential cross section of 0.4 Å^2/sr. Measured values of integral and differential total cross sections for Li^+–He and Li^+–H_2 are reported and compared with theory. Direct dissociation of D_2 by Li^+ in the energy range from 25 to 55 eV was not observed, yielding an upper limit for the cross section of $4 \cdot 10^{-4}$ Å^2/sr. (auth)

43913 THE CORRECTION FOR PHOTON PILE-UP IN THE MEASUREMENT OF RADIATIVE LIFETIMES. Coates, P. B. (National Physical Lab., Teddington, Eng.). J. Phys., E, 1: 878-9(1968).

In determinations of radiative lifetimes of atomic energy levels in which time intervals are measured up to the first-detected photon, an error is introduced when subsequent photons are neglected. An accurate correction for this effect is described, having the advantages of general applicability and allowing the use of high photon detection rates. (auth) (UK)

43914 DEGENERATE SOLUTIONS OF THE ELECTRON BEAM EQUATION. Danilov, V. N. Zh. Prikl. Mekh. Tekh. Fiz., No. 1, 3-12(Jan.-Feb. 1968). (In Russian).

Exact solutions were derived for stationary electron beams which are degenerate in Cartesian axially symmetric and spiral coordinate systems. The degeneracy was established by the fact that at least two coordinates are cyclic or are motion integrals. In most cases turbulent beams were examined, following up earlier studies on the invariant solution of beams, in which the vortex causes a linear correlation with the coordinates of the electric field potential. In the degenerate solution, the presence of a vortex leads to quadratic or more complex correlations between the potential and the coordinates of the motion integral. The equations used were derived from the hydrodynamic equations for stationary relativistic electron beams. The cases considered included solenoid-type, relativistic plane beams, and spiral, nonrelativistic beams. The effect of the vortex in a plane beam pulse was found to be equivalent to the compensating action of a periodic magnetic field on a vortex-free plane beam possessing the same geometry. (TTT)

43915 ON ASYMPTOTIC EXPANSIONS OF ELECTRONIC TERMS OF THE MOLECULAR ION H_2^+. Damburg, R. J.; Propin, R. Kh. (Univ. of Colorado, Boulder). J. Phys., B, 1: 681-91 (July 1968).

The behavior of electronic terms and wave functions of the molecular ion H_2^+ for large internuclear separations is considered. Comparisons of asymptotic formulae with numerical calculations are presented. (auth)(UK)

43916 POTENTIAL ENERGY CURVES OF H_2^-. Burke, P. G. (Queen's Univ., Belfast). J. Phys., B, 1: 586-8(July 1968).

General requirements of analyticity and unitarity are shown to give restrictions on the possible behavior of the complex potential energy curves of H_2^-. It is argued that these restrictions may be of importance in processes such as dissociative attachment. (auth)(UK)

43917 THEORY OF ATOMIC STRUCTURE INCLUDING ELECTRON CORRELATION. Sinanoglu, Oktay; Oksuz, Iskender (Yale Univ., New Haven). Phys. Rev. Lett., 21: 507-11(Aug. 19, 1968).

A theory of atomic structure treating electron correlation for excited and ground configurations is developed, and applied to 113 states of the $1s^k2s^n2p^m$ type, in boron through sodium and their ions. Predictions agree better with experiment than the traditional methods. (auth)

43918 MATHEMATICAL FOUNDATIONS OF QUANTUM MECHANICS. A Lecture-Note Volume. Mackey, George W. The Mathematical Physics Monograph Series. New York, W. A. Benjamin, Inc., 1963. 147p.

Quantum mechanics and certain parts of classical physics are explained from a mathematician's point of view. The emphasis is on generality and careful formulation rather than on problem solving techniques. An outline of a completely rigorous treatment is presented. An attempt is made to define all physical concepts used in terms of those of pure mathematics and the basic ones of space and time. The fundamental viewpoint is that the change in time of a physical system may be described by a one-parameter semi-group U acting on a set S, and that the laws of physics make assertions about the structure of S and the infinitesimal generator of U. Applications to atomic physics are also given. (J.F.P.)

43919 USE OF RECIPROCITY RELATION IN THE PROBLEMS OF MOVING CHARGE RADIATION. Egorov, L. A.; Miller, M. A. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 730-9(1968). (In Russian).

The problems of finding the radiation field of moving charged particles were considered on the basis of the electrodynamic principle of reciprocity. An expression is derived for the radiation field of a point charge moving in an arbitrary manner in an isotropic medium with the irregularities given. On this basis, a somewhat new classification of radiation of moving charges is presented; namely, synchronous (Cherenkov) radiation, radiation arising from irregular movement (bremsstrahlung), and radiation due to auxiliary field irregularity (transient). As an example illustrating the possibilities of the method of the reciprocity theorem, there is considered the radiation for a quasi-regular movement of a charged particle in a weakly homogeneous medium (the geometrical optics approximation). The result is of universal form suitable both for the transient and the bremsstrahlung radiations. In the case of strong irregularities the field radiation may be calculated by means of the known function only for some successful movements and distributions of an auxiliary field. The radiation field of a charge moving straightforward in the inhomogeneous medium with the velocity $v(z) = v_0/(1 + \gamma^2z^2)$ was found. All the peculiarities of formation of the different types of radiation may be followed by this example. (auth)

43920 STOPPING POWERS AND RANGES OF 5 TO 90-MeV ^{32}S, ^{35}Cl, ^{79}Br, AND ^{127}I IONS IN H_2, He, N_2, Ar, AND Kr: A SEMIEMPIRICAL STOPPING POWER THEORY FOR HEAVY IONS IN GASES AND SOLIDS. Pierce, T. E.; Blann, Marshall (Univ. of Rochester, N. Y.). Phys. Rev., 173: 390-405(Sept. 10, 1968).

Stopping powers and range curves for approximately 5- to 90-MeV beams of ^{32}S, ^{35}Cl, ^{79}Br, and ^{127}I in H_2, He, N_2, Ar, and Kr are presented. Polynomial fits to the range curves followed by differentiation showed the $\Delta E/\Delta X$ measurements to be equivalent to dE/dX to within experimental uncertainties. The experimental stopping powers are estimated to have errors no greater than ±3% for ^{32}S and ^{35}Cl, ±4% for ^{79}Br, and ±5% for ^{127}I. Integral ranges should be accurate to ±1% or better. Small corrections for nuclear stopping were applied to the stopping powers, and the resulting stopping powers were analyzed in terms of fractional effective charge, defined as the quotient of the charge giving the correct stopping power in the Bethe equation to the nuclear charge, using experimental proton stopping powers. The same was done for published heavy-ion stopping powers in solids (Be, C, Al, Ni, Ag, and Au); and the fractional effective charges γ were compared against a reduced velocity parameter $v_r = v/(v_0Z^{2/3})$, where v is the ion laboratory velocity and $v_0Z^{2/3}$ is the Thomas–Fermi electron velocity. All data so analyzed fell on a single smooth curve of γ versus v_r to ±3%, with the exception of some of the data taken in H_2. The curve may be parametrized as $\gamma = [1 - \exp(-0.95\ v_r)]$. For the reduced-velocity region $v_r \geq 0.1$, electronic stopping powers may be computed from the semiempirical relationship $(dE/dX)_{Z,A,E} = (dE/dX)_{p,E/A}Z^2[1 - \exp(-0.95\ v_r)]^2[1 - \exp(-2.5\ v_p)]^{-2}$, where Z, A, and E represent the atomic number, mass number, and kinetic energy of the heavy ion; the dE/dX factor subscripted p, E/A denotes the experimental proton stopping power for protons of energy E/A; v_r is the reduced velocity of the heavy ion; and v_p is the proton velocity in units of MeV$^{1/2}$. To the extent that the extrapolations of the correlations found in this work are valid, stopping powers so calculated should be accurate to ±8%. The effective charge parameter for gases and solids is approximately equivalent to the root-mean-square (rms) charge for the same ions in gas. The effective charges for heavy ions in solids are thus shown to differ markedly from the rms charges measured for solid stripping foils. These data suggest that the extra electrons are bound while the ion is in the solid and are lost when the ion leaves the stripping foil. (auth)

43921 RADIATIONLESS ANNIHILATION OF POSITRONS IN LEAD. Shimizu, Sakae; Mukoyama, Takeshi; Nakayama, Yasuyuki (Kyoto Univ.). Phys. Rev., 173: 405-16(Sept. 10, 1968).

A process of positron annihilation without emission of radiation, radiationless or zero-quantum annihilation, has been investigated experimentally. A theory for this phenomenon has also been developed. The 300-keV positrons were focused on a thin lead target by the use of a Siegbahn–Slätis intermediate-image spectrometer mounted with ^{22}Na as a positron source. The shell electrons ejected from the lead foil were observed with a lithium-drifted silicon detector mounted immediately behind the foil. A small peak was observed in the expected energy region of the electron spectrum. This has been attributed to the shell electrons ejected from the lead foil. The effect of target thickness has been examined carefully. The experimental data obtained were used in an attempt to estimate the total cross section of this annihilation process in lead. The experimental result is $\sigma_{\text{exptl}} = 0.8^{+0.4}_{-0.3} \times 10^{-26}$ cm^2 as a sum of those for K–K, K–L, K–M, and L–L pairs of shell electrons in a lead atom for 300-keV positrons. The calculated cross section obtained is $\sigma_{\text{calc}} = 0.727 \times 10^{-26}$ cm^2. The experimental value is in agreement with the calculated result within the experimental error. (auth)

43922 BROADENING OF LINES FROM IONIZED NITROGEN, CARBON, AND OXYGEN. Subrahamiam, P. (Osmania Univ., Hyderabad, India). Mon. Notic. Roy. Astron. Soc., 140: 1-8 (1968).

The susceptibility of lines from ionized nitrogen, carbon, and oxygen, to broadening, when the respective gases in capillary discharge tubes were subjected to high-voltage condensed discharges, was investigated, and an attempt was made to correlate the selective broadening of lines with the behavior of spectral lines in Wolf–Rayet stars. A good correspondence between the two was obtained, which suggests Stark effect to be an important cause in broadening the lines from ionized atoms of other elements in stars, besides hydrogen and helium. (auth) (UK)

43923 EQUATIONS FOR CALCULATION OF ION PENETRATION INTO A MATTER. Kessel'man, V. S. At. Energ. (USSR), 24: 557-63(June 1968). (In Russian).

Analytical equations based on the theory L. Lindhard and others are given for the calculation of ion penetration depth into matter. These are one-parameter equations (with k parameter designed by LSS theory) with variable ρ, ϵ. For different ions and atoms of retarding matter and the energies of ions from some keV to 17-MeV experimental data differ from estimate values not more than 10%. Analytical equations capable to be the criterion of ion energy loss on the electrons of the retarding matter atoms are given. (auth)

43924 METHOD OF THE REGULATION OF THE INTRODUCTION OF THE SUBSTANCE TO BE EVAPORATED INTO THE ION SOURCE. Makov, B. N.; Dmitriev, E. A. Prib. Tekh. Eksp., No. 3, 202-4(May-June 1968). (In Russian).

A low-inertia evaporator, used for automatic regulation during introduction of vapor into the ionizer and for the control of the consumption is described. The device has a simple construction and does not require heating of all the reserves of the working material up to the evaporator temperature. The test results obtained with Pb and Bi are reported. (tr-auth)

43925 ELECTRON ENERGY LOSS SPECTRA FOR EVAPORATED CARBON FILMS. Burge, R. E.; Misell, D. L. (London Univ.). Phil. Mag., 18: 251-9(Aug. 1968).

The distributions of electron energy loss (range 10 to 100 eV) from films of evaporated carbon were studied for a range of film thicknesses from 165 to 835 Å and a range of electron energies from 23 to 70 keV. It is shown that these distributions may be predicted, within a deviation of a few percent, for energy losses less than above 200 eV, and the mean free path λ_i for inelastic electron scattering is determined for each electron energy. These values of λ_i are in good agreement with the experimental values of Brünger and Menz (1965) and with theoretical values evaluated using the Bohm–Pines plasma oscillation theory. (auth) (UK)

43926 ELECTRON ENERGY LOSS SPECTRA FOR ALUMINIUM. Burge, R. E.; Misell, D. L. (London Univ.). Phil. Mag., 18: 261-8(Aug. 1968).

It is shown that the electron energy loss distributions observed in electron transmission (energy 23 to 70 keV) through Al films 435 Å to 1950 Å thick may be predicted in the energy ranges from 5 to 100 eV within a deviation of a few percent. The prediction is made in terms of assumed electron energy loss distributions for the principal volume and surface losses which are centered, respectively, at about 15 and 7 eV. Consistent values of λ_i, the mean free path for single (volume) inelastic scattering into all angles, are evaluated for six electron energies in the given range. An attempt was made to evaluate in detail the effects on the observed energy loss spectra of the energy loss distributions arising from surface and surface–volume electron interactions. The determined values of λ_i are in good agreement with the plasma oscillation theory. (auth) (UK)

43927 CHARACTERISTIC ENERGY LOSSES OF LOW-ENERGY ELECTRONS REFLECTED FROM ALUMINIUM AND COPPER. Thirlwell, J. (Imperial Coll. of Science and Tech., London). J. Phys., C, 1: 979-89(Aug. 1968).

The characteristic energy loss spectra of electrons reflected from freshly evaporated Al and Cu specimens were measured for various primary electron energies in the range 9 to 265 eV. Contrary to expectation the ratio of the intensity of the 10 eV surface plasma loss to that of the 15 eV volume loss in Al, for electrons scattered through 90°, was found to decrease with decreasing primary energy in the range from about 240 to 80 eV. This appears to be due to the behavior of the surface loss, which decreases rapidly in intensity with decreasing primary energy. Both the surface and volume plasma losses of Al cease to be excited when the primary energy is less than about 26 to 29 eV, the surface loss cutting off at a slightly lower primary energy than the volume loss. The modified surface loss of Al resulting from oxidation of the specimen surface was observed at 7.1 eV, and the half-width of the 10-eV surface loss increased from 3.8 to 5.3 eV with increasing surface oxidation, indicating that the surface plasma oscillations are damped by the contamination. The energy losses of Cu were investigated by observing their intensity dependence on (i) the primary electron energy for a fixed scattering angle of 90° and (ii) the electron-scattering angle for various fixed primary energies, scattering angles of 90 and 20° being employed. The results indicate that a loss observed at 3.5 eV is possibly due to excitation of surface plasma oscillations. (auth) (UK)

43928 BOUNDS ON TRANSITION PROBABILITIES AND CROSS SECTIONS. Aspinall, L.; Percival, I. C. (Univ. of Stirling, Scotland). J. Phys., B, 1: 589-96(July 1968).

The upper bound on the total transition probability p(t) previously obtained by Aspinall and Percival in 1967 is generalized to systems with an infinite or arbitrary finite number of states and to arbitrary time-dependent trial states $|\Psi_{tr}(t)\rangle$. A bound on total inelastic cross sections is obtained for collisions between heavy systems with sufficiently short-range interaction potentials. The method is applied in its simplest form to H–H and p–H collisions, but gives results of little physical significance. A reason is given and possible remedies suggested. A variational method for time-dependent states is proposed. (auth) (UK)

43929 OSCILLATORY ENERGY DEPENDENCE OF RESONANT ELECTRON–MOLECULE SCATTERING. Herzenberg, A. (Univ. of Manchester, Eng.). J. Phys., B, 1: 548-58(July 1968).

The cross sections for the vibrational excitation of N_2 molecules bombarded by electrons show a strong peak between 2 and 3 eV, split up into a regular sequence of minor peaks reminiscent of distinct resonances. The minor peaks appear, however, in the different final channels at different energies and with slightly different spacings, a behavior which could be understood on the resonance picture only as the result of some interference effect. An explanation is offered, based on the assumption that the nuclear wave function in the intermediate N_2^- ion is a standing wave whose amplitude varies slowly, and whose nodes move slowly as the energy changes. As the nodes drift over the nodes of the final states of the residual molecule the overlap integrals of the intermediate and final states oscillate, and hence the cross sections oscillate too. The spacing of the minor peaks in energy and their relative displacement for the different final states can be understood in terms of the drifting nodes in an energy representation, and in the corresponding time representation, in terms of the motion of the nuclear wave packet. (auth) (UK)

43930 SEARCH FOR THE FORMATION OF H_2^- IONS FROM 40-keV H_2^+ IONS IN HYDROGEN. Main, I. G.; Durell, J. L.; Sareen, R. A. (Univ. of Liverpool). J. Phys., B, 1: 755-7(July 1968).

No evidence was found for the production of H_2^- ions when 40 keV H_2^+ ions were passed through a hydrogen gas target. (auth) (UK)

43931 ELECTRON COLLISION CROSS SECTIONS AND GENERALIZED OSCILLATOR STRENGTHS FOR POTASSIUM. Hertel, I. V.; Ross, K. J. (Southampton Univ., Eng.). J. Phys., B, 1: 697-704(July 1968).

A crossed-beam electron spectrometer using hemispherical electrostatic velocity analyzers is described. Electron energy-loss spectra for K were obtained at 41-, 51-, 68-, 101-, and 201-eV incident electron kinetic energies. The f-sum rule was used to obtain generalized oscillator strengths and absolute differential cross sections for the transitions $4\,^2S \rightarrow 4\,^2P$, $5\,^2S$, $3\,^2D$, $5\,^2P$, $4\,^2F$, $6\,^2P$. The reduced matrix element $(4\,^2S||r^2||5\,^2S)$ was found to be 54 a.u., and the electric quadrupole transition probability for $3\,^2D \rightarrow 4\,^2S$ found to be 5×10^2 s^{-1}. A method is suggested for absolute calibration of atomic beams in crossed-beam experiments. (auth) (UK)

43932 SCATTERING OF ELECTRONS BY Mg^+ AND Ca^+ IONS. Burke, P. G.; Moores, D. L. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., B, 1: 575-85(July 1968).

The close-coupling approximation is applied to the problem of scattering of electrons by Mg^+ and Ca^+ ions. Positions and widths of autoionizing states of the corresponding neutral atoms are calculated and, in the case of Ca, compared with experiment. The electron impact excitation cross sections for the 3s → 3p and 3s → 3d transitions in Mg^+ and for the 4s → 4p and 4s → 3d transitions in Ca^+ are calculated with and without exchange. Agreement with Coulomb–Born calculations is quite good. (auth) (UK)

43933 SECONDARY ION EMISSION FROM METALS OF THE FIRST TRANSITION SERIES. Blaise, Guy; Slodzian, Georges (CNRS, Orsay, France). Compt. Rend., Ser. A and B, 266: 1525-8(June 17, 1968). (In French).

The rate of ionization of metals of the first transition series, bombarded by 6-keV Ar^+ ions, is measured. For chromium and copper the process considered is one of ionization, at a distance from the surface, of the atom ejected in a metastable state requiring a hole in the 3d shell. For the other metals, the ionization comes about by the same process, but in addition, the existence of autoionizing configurations where only two 4s electrons are excited leads to an increased possibility of their emission. The process can be generalized for the interpretation of the formation of polyatomic ions. (tr-auth)

43934 INTERPRETATION OF ELASTIC SCATTERING IN REACTIVE SYSTEMS. Nyeland, Carl; Ross, John (Massachusetts Inst. of Tech., Cambridge). J. Chem. Phys., 49: 843-5 (July 15, 1968).

Semiclassical approximations are applied to the optical model to derive and discuss an equation used in the interpretation of measurements of elastic scattering in reactive systems. (auth)

43935 HOT-ATOM REACTION YIELD AND ENERGY DISTRIBUTION. Thomsen, P. V. (Univ. of Aarhus, Denmark). J. Chem. Phys., 49: 756-62(July 15, 1968).

A general integral equation for the reaction probability of energetic ions slowing down in an arbitrary system is formulated. The equation is found to be equivalent to the Boltzmann equation for the energy distribution of incoming particles. An approximate solution corresponding to continuous slowing down is derived, expressing, e.g., the energy distribution through the flux distribution of incoming particles, the stopping power of the system, and the reaction cross sections. The approximate solution for the energy distribution is better the softer the potential, and is found to be accurate if stopping is dominated by target atoms with mass widely different from the mass of the incoming particles. In case of equal masses, the discrepancy is of the order of 50% for a nonreactive system and realistic interactions. (auth)

43936 HIGH-RESOLUTION ENERGY-LOSS SPECTRUM OF MOLECULAR OXYGEN. Geiger, J.; Schroeder, B. (Technische Univ., Berlin). J. Chem. Phys., 49: 740-4(July 15, 1968).

The spectrum of molecular oxygen has been studied in the energy-loss range 6.8 to 21 eV by means of a high-resolution electron energy-loss spectrometer using 25-keV primary electrons. The resulting energy-loss spectrum was compared with the uv absorption spectrum. In contrast to the results for nitrogen, fair agreement is stated disregarding some deviations in the Schumann-Runge region. At high energy ($E > 17$ eV) the resolution in the energy-loss spectrum exceeds that of the absorption spectrum. Some bands could be grouped new. (auth)

43937 PROPERTIES OF THE SPECULAR LOW-ENERGY ELECTRON BEAM SCATTERED BY FACE-CENTERED CUBIC METAL SINGLE-CRYSTAL SURFACES. Goodman, R. M.; Farrell, H. H.; Somorjai, G. A. (Univ. of California, Berkeley). Contract W-7405-Eng-48. J. Chem. Phys., 49: 692-700(July 15, 1968). (UCRL-17983).

The intensity, I_{001}, of the specularly reflected low-energy (10 to 500 eV) electron beam was monitored for the different low-index crystal faces of palladium, platinum, and lead as a function of electron energy (eV). The properties of the I_{001} (eV) curves were investigated as a function of temperature, crystal orientation, scattering angle, and the appearance of different ordered surface structures. For clean surfaces, the positions of the intensity peaks were insensitive to variation of temperature. They were found to change markedly, however, with variation of the scattering angle and the formation of new surface structures on the Pd (100) face. A "reduced" electron-energy scale was used to compare the intensity curves obtained for the different face-centered cubic metal surfaces. The same crystal face of the different metals yields similar intensity curves. Correlations between intensity curves from different surfaces of the same metal are also pointed out. The occurrences of maxima and minima in the intensity of the specularly scattered low-energy electron beam are primarily determined by the periodicity of the crystal lattice rather than the nature of the crystal potential. However, the relative intensities of the diffraction features are sensitive to variations in the crystal potential. (auth)

43938 ENERGY SPECTRUM OF EJECTED ATOMS DURING THE HIGH-ENERGY SPUTTERING OF GOLD. II. Thompson, M. W. (Univ. of Sussex, Brighton, Eng.). Phil. Mag., 18: 377-414(Aug. 1968).

Using the technique described in part I, the energy spectrum of sputtered atoms was determined for several gold specimens, both single crystals and polycrystalline aggregates. The ⟨110⟩, ⟨110⟩ and ⟨121⟩ directions of ejection were chosen for the experiments. Bombardment was with either 43-keV A^+ ions, 43-keV Xe^+ ions or 66-keV Xe^+ ions. The energies of the ejected atoms ranged from about 10^{-2} eV up to about 10^4 eV. A peak was generally observed in the energy spectrum between 1 and 10 eV. On the high-energy side of this peak the spectrum behaved roughly as E^{-2}, though there were significant deviations from this, particularly for ⟨100⟩ ejection. A theoretical model was developed in which ejection results principally from the generation of atomic collision cascades by the bombarding ion. The assumptions that energy in the cascades is shared by two-body collisions and that the mean collision free path is independent of energy lead to an E^{-2} spectrum, and this prediction should hold roughly from 10 to 10^3 eV. It is shown that the consequence of surface binding of atoms, with a binding energy E_b, is a refraction of atomic trajectories and a peak in the spectrum near $E = E_b$. This random cascade model is unable to explain all features of the spectra, particularly the sharp peaks that appear when plotted as time-of-flight spectra. But a more advanced model, which allows for the generation of focused collision sequences by the cascade, fits the data extremely well. This allows for both types of sequence, assisted and simple, and represents their separate characteristics realistically. Deviations from the predictions of the advanced model are confined to energies below 1 eV, where thermal spikes are thought to contribute, and above 10^3 eV, where the collision free path is probably enhanced by channeling and the normal decrease in cross section with energy. At room temperature the discrepancy only amounts to about 10% of the total sputtering yield. The random cascade and focused collision sequences contribute roughly equal amounts. From a comparison of the predicted and observed spectra it can be deduced, firstly, that for simple focused collision sequences traveling along the ⟨110⟩ rows the maximum energy of propagation is 167 ± 25 eV and the maximum range is at least 21 collisions; secondly, that for ⟨100⟩ assisted sequences the energy limit is 500 ± 100 eV and the maximum range is about 23 collisions; thirdly, that the effective binding energy to the gold surface in these experiments varied from 2.5 to 4.1 eV. An interatomic potential for Au is deduced, consistent with the observed ⟨110⟩ focusing energy and the bulk modulus of elasticity. In the Born-Mayer form, A exp (−r/b), the constants are A = 200 ± 60 keV and b = 2.88/(14.3 ± 0.4) Å, valid from 1.4 to 2.88 Å. The random cascade model leads to the following rough expression for sputtering ratio with high energy heavy ions for which the inverse-square interatomic potential is valid:

$$S = \frac{\pi^2 \alpha_0^2 n^{1/2}}{8e} \frac{E_R}{E_b} \frac{M_1 (Z_1 Z_2)^{1/2}}{M_1 + M_2} \sec \psi$$

where α_0 is the Bohr radius, n is the density of atoms, E_R the Rydberg energy, E_b the binding energy, M_1, M_2, Z_1, Z_2 the masses and atomic numbers of the bombarding and target atoms, and ψ is the angle of incidence. This is in fair agreement with experiment, provided effects such as channeling of the incident ion are excluded. (auth) (UK)

43939 ENERGY SPECTRA FOR COPPER. III. Farmery, B. W.; Thompson, M. W. (Univ. of Sussex, Brighton, Eng.). Phil. Mag., 18: 415-24(Aug. 1968).

In Cu results generally similar to those for Au are found, but with a reduction of all focusing energies. Ejection in a direction away from a focusing or channeling axis gave a spectrum that fitted extremely well to the random cascade model. Near the ⟨110⟩ direction the spectra can again be understood in terms of random cascades plus focused collision sequences, though the energy loss characteristics of the sequences evidently differ from the case of ⟨110⟩ focusing in Au. The ⟨110⟩ focusing energy is found to be 50 ± 10 eV, in fair agreement with predictions of Gibson, Goland, Milgram, and Vineyard (1960). The apparent focusing energy increases in moving away from the focusing axis, reaching 90 eV at 10° from ⟨110⟩. This shows how defocused sequences propagate above the focusing energy. In changing from Al^+ to Xe^+ ions at 43 keV the apparent focusing energy remains unaltered though the ratio of contributions from random and focused ejection is decreased. This confirms that the features of the spectrum attributed to focusing are not a function of the bombarding ion. In the ⟨100⟩ direction the spectrum again shows the effect of random cascades plus focused collision sequences with a propagation limit of 320 ± 50 eV. (auth)

43940 A MECHANICAL SPECTROMETER FOR ANALYSING THE ENERGY DISTRIBUTION OF SPUTTERED ATOMS OF COPPER OR GOLD. I. Thompson, M. W. (Univ. of Sussex, Brighton, Eng.); Farmery, B. W.; Newson, P. A. Phil. Mag., 18: 361-76(Aug. 1968).

A time-of-flight technique was used to determine the energy spectrum of atoms ejected by ion bombardment from a metal target. The ion beam was pulsed in synchronism with a magnetically suspended rotor, spinning at speeds up to 3000 rev. sec^{-1}. The flight path of 50 cm between target and rotor was sufficient to obtain a dispersed deposit of atoms on the rim of the rotor for all atom energies up to about 10 keV. The deposit was detected by autoradiography, the Cu or Au targets having been previously activated by irradiation with thermal neutrons. (auth) (UK)

43941 PSEUDOPOTENTIAL THEORY OF ATOMS AND MOLECULES. I. A NEW METHOD FOR THE CALCULATION OF CORRELATED PAIR FUNCTIONS. Szasz, Levente (Fordham Univ., New York). J. Chem. Phys., 49: 679-91(July 15,1968).

It is shown that in all previously developed methods for the calculation of correlated pair functions the mathematical difficulties arise from the fact that the pair functions must be orthogonalized to the one-electron spin orbitals by the orthogonality projection operator $(1 - \Omega_{12})$. Since this is an integral operator, if the pair functions are of Hylleraas type, containing r_{12}, the orthoganalization will introduce integrals which are very time consuming to calculate. It is shown that the orthogonality projection operator can be transformed in good approximation into pseudopotentials, for which explicit expressions are derived. On the basis of this transformation a new method is developed for the calculation of correlated pair functions. (auth)

43942 INFLUENCE OF THERMAL OSCILLATIONS OF A CRYSTAL LATTICE ON THE ANISOTROPY OF THE SPUTTERING COEFFICIENTS AND THE ION-ELECTRON EMISSION OF SINGLE CRYSTALS. Evdokimov, I. N.; Molchanov, V. A.; Odintsov, D. D.; Chicherov, V. M. (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 177: 550-3(1967). (In Russian).

The results of certain experiments aimed at assessing the relative role of the two possible mechanisms of sputtering, namely the diffusion mechanism and the focuson mechanism, are reported. The tests consisted of irradiating the (110) and (111) faces of single-crystal and polycrystalline copper by 30-keV argon ions. The procedure for determining the sputtering and emission coefficients was the same as in an earlier investigation. Provisions were made for taking into account the effect of evaporation at high temperatures. The results are presented in the form of plots of the sputtering coefficient and the ion–electron emission coefficient on the angle of incidence, and of the temperature dependence of the sputtering and emission coefficients. Since it was impossible to take into account the role of all the processes affecting the sputtering and the electron emission, the experimental results were compared only with the results of an idealized calculation which takes into account only the change in the transparency of the crystal with change of temperature. This approximation turned out to be valid for the electron emission but not for the sputtering. The results favor the focuson interpretation of the sputtering mechanism. The results also show that the factors neglected in the calculation are not very significant. (ATD)

43943 CALCULATIONS ON ELECTRON CAPTURE FROM D, He, N, O, AND Ar BY PROTONS. Mapleton, R. A. (Air Force Cambridge Research Labs., Bedford, Mass.). J. Phys., B, 1: 529-36(July 1968).

Cross sections are calculated for (A) $H^+ + He(1s^2) \rightarrow H(1s) + He^+(1s)$ at impact energies E in the range $0.1 \text{ MeV} \leq E \leq 100 \text{ MeV}$, using the prior and post interactions with the wave version of the first Born approximation. Cross sections for (A) and (B) $H^+ + D(1s) \rightarrow H(1s; 2s) + D^+$ are also calculated for $20 \text{ keV} \leq E \leq 100 \text{ MeV}$, using the distorted-wave interaction with the Born approximation. The cross sections of (B) agree with the calculated values of McCarroll (1961) and of McElroy (1963) for capture from H(1s), and the distorted-wave cross sections of (A) are also in good accord with those of Bransden and Sin Fai Lam (1966). Newly calculated OBK cross sections for all subshells of Ar and previously calculated OBK values for N and O are used to obtain estimates of the total cross sections for capture by protons in the range $20 \text{ keV} \leq E \leq 100 \text{ MeV}$. These predictions are likewise in fair accord with the measured values per gas atom of N_2, O_2, and Ar by Schryber, Welsh et al. (1967) and Barnett and Reynolds (1958). Certain features of these cross sections are similar to the classical calculations by Bates and Mapleton (1967) and by Mapleton (1961–7). The approximate effective Born prior interaction at high energies is used to derive the approximate asymptotic ratio $L(Z) = \lim_{E \to \infty} Q(i)/Q(OBK)$ for the capture of 1s-orbital electrons from a neutral target of atomic number Z. It is found that L(Z) increases monotonically for increasing Z, and this increase possibly indicates a defect in the Born prior and post formulations. (auth) (UK)

Cosmic Radiation

Refer also to abstracts 43024, 43056, 43187, 44323, and 44650.

43944 (AECL-3140) COSMIC RAY NM-64 NEUTRON MONITOR DATA. IX. Monthly Graphs, January 1968–April 1968. Steljes, J. F. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). June 1968. 67p. Dep. CFSTI. CAN $1.50.

Uncorrected and barometer-corrected results from the cosmic-ray stations in Canada, using equipment maintained by AECL, are given in tabular form for the period from January to April, 1968. Normalized graphs are given for this period. A warning about defective barometer vacuum at two stations is included. (auth)

43945 ANTIPROTONS AND POSITRONS IN COSMIC RAYS. Shen, C. S.; Berkey, G. B. (Purdue Univ., Lafayette, Ind.). Phys. Rev., 171: 1344-8(July 25, 1968).

The antiproton flux in primary cosmic rays is treated by calculating the ratio of antiproton to positron production in nuclear collisions. It is shown that in the few-BeV energy range at earth, the ratio of the antiproton flux to the positron flux is given directly by their production-cross-section ratio and is independent of astronomical uncertainties. At higher energy, the equilibrium intensity ratio deviates from the production ratio due to modulation in interstellar space. The antiproton production cross section is deduced from the pion production cross section on the basis of a simple physical argument. By comparison with the observed positron intensity, an antiproton flux is obtained which is approximately 10^{-4} of the proton flux for $E \geq 5$ BeV and falls off rapidly below 2 BeV. It is suggested that a detection of cosmic-ray antiprotons in the lower energy range would test the validity of the nuclear-interaction model used in the calculation, while extension of the measurements to higher energies, which is perhaps difficult experimentally at present, would serve as a useful probe in the study of the origin and propagation of secondary cosmic-ray particles. (auth)

43946 ORIGIN OF PRIMARY COSMIC RADIATION AND ITS ANTIPROTON COMPONENT. Wayland, J. R.; Bowen, Theodore (Univ. of Arizona, Tucson). Phys. Rev., 171: 1376-85(July 25, 1968).

A Fokker–Planck diffusion equation was solved for the diffusion and acceleration of cosmic rays. A time-independent solution is obtained by assuming that the contributions to the present intensity of particles injected at a uniform rate during all past times is equivalent to summing the intensities over all future time of particles injected at a given time. Contrary to the usual dependence upon an average acceleration, continuous deceleration and fluctuations in acceleration were used to explain the energy spectrum. This gives a general expression for a power-law spectrum in which the exponent varies as $\gamma = 0.093 \ln (E/m) + 1.75$, thus allowing a very good fit to the experimental energy spectrum. A previously developed expression for the production of antiprotons is then applied to obtain an injection spectrum. This and the above solutions are then applied to three extreme cases of possible origin. The resulting antiproton spectra depend upon whether the material encountered by primary cosmic-ray protons is mostly inside or outside the regions of acceleration. The relative ratio of antiprotons to protons with $E > 10$ GeV is expected to be about 10^{-6} if the protons have passed through 2 to 3 g/cm^2 of material. (auth)

43947 COSMIC-RAY ASTROPHYSICS. Ginzburg, V. L. (Lebedev Physical Inst., Moscow). pp 289-305 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967.

The entire set of problems involved in cosmic-ray research can be called cosmic-ray astrophysics. The present paper is a short survey of the contemporary status of this field. Topics covered include primary cosmic rays in the vicinity of the Earth, cosmic rays and synchrotron emission, cosmic rays and gamma-ray astronomy, and cosmic rays in the Universe. (W.D.M.)

43948 THE ATMOSPHERIC AND LEAKAGE FLUX OF NEUTRONS PRODUCED IN THE ATMOSPHERE BY COSMIC RAY INTERACTIONS. Boella, G.; Dilworth, C.; Panetti, M.; Scarsi, L. (Univ., Milan). Earth Planet. Sci. Lett., 4: 393-8(July 1968).

The curve of the integrated neutron flux in the "thermal" to 20-MeV energy range, as a function of the atmospheric depth from sea level up to 0.1 mbar, was determined, assuming as energy spectrum that predicted by Newkirk. The instrument employed was a combination of a hydrogeneous moderator with a slow neutron detector, with anticoincidence rejection of background events. Four balloon flights were carried out in March 1966; one rocket flight in July 1966. With this flight the curve was extended to 0.1 mbar from 6 mbar, attained with the balloon flights. The neutron flux as a function of the atmospheric depth is given, at 5.3 GV geomagnetic rigidity, in quiet Sun conditions. The albedo neutron flux was measured: (0.42 ± 0.04) neutrons cm^{-2} sec^{-1}. The mean free path for absorption in the atmosphere is: L = (165 ± 5) g cm^{-2}. The maximum intensity was found at (90 ± 10) g cm^{-2} residual pressure. (auth)

43949 GEOMAGNETIC CUT-OFF RIGIDITIES IN NON-VERTICAL DIRECTIONS. Bland, C. J.; Cioni, G. (Univ., Milan). Earth Planet. Sci. Lett., 4: 399-405(July 1968).

The value of the cutoff rigidity in a given direction below which charged particles arriving from infinity are excluded, is a parameter of fundamental importance in the interpretation of cosmic-ray measurements. Whereas listings of the cutoff rigidity in the vertical direction are available from several sources for several locations, no such information is generally available for nonvertical directions. It is shown how the application of Euler potentials originally developed by Ray for the description of the geomagnetic field in problems dealing with the motion of charged particles in this field, permits a relatively simple method of calculating cutoff rigidities in any given direction. Evidence is presented to show that the precision afforded by this method is adequate at intermediate latitudes and permits savings on computer time as compared with step-by-step orbit tracing methods. Results are presented for two European locations which are used for the launching of balloons for upper atmosphere investigations and results for other locations are available on application. (auth)

43950 DIFFUSE X-RAY BACKGROUND OF COSMIC SPACE. Vainshtein, L. A.; Kurt, V. G.; Mandel'shtam, S. L.; Presnyakov, L. P.; Syrovatskii, S. I.; Syunyaev, R. A.; Tindo, I. P. Kosm. Issled., 6: 242-6(Mar.-Apr. 1968). (In Russian).

The experimental results of the measurement of the x-ray isotropic background in the energy range $E > 1$ keV, including new measurements in the range near 1.25 keV, were examined. Two possibilities, explaining the x-ray background, were analyzed: the Compton radiation of the metagalactic relativistic electrons and bremsstrahlung radiation of the heating of the metagalactic gas. In the latter case the most probable density of the intergalactic medium is equal ~0.2 from the critical and the temperature of the intergalactic gas is 3 to 10 × 10^{7}°K. (tr-auth)

43951 SPECTRUM OF NUCLEAR ACTIVE PARTICLES AT 3200 m ABOVE SEA LEVEL. Grigorov, N. L.; Shestoperov, V. Ya. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 5, 41-9 (Sept.-Oct. 1968). (In Russian).

Energy spectra of nuclear-active particles were measured at 3200 m using ionization-burst recording instruments and ionization calorimeter. The design of the ionization-burst recording device is given. The device is capable of recording π^0 mesons with energies up to 2×10^{13} eV. The energy spectra of electromagnetic cascades were constructed and the data obtained from the combined instruments were analyzed. (R.V.J.)

Direct Energy Conversion

Refer also to abstracts 43195, 43634, 43973, and 44097.

43952 (BNL-12569) HYBRID FOSSIL-NUCLEAR FUELED MHD POWER CYCLES. Steinberg, M.; Powell, J.; Beller, M.; Manowitz, B. (Brookhaven National Lab., Upton, N. Y.). June 1968. 15p. Dep. CFSTI.

A description is given of three alternate combination fossil nuclear fueled MHD power cycles (combination of a coal gasifier with a MHD generator): H_2-O_2, $CO-O_2$, and $CO + H_2$-air. The reforming and combustion reactions in each cycle are described, and their advantages and disadvantages are compared. Energy balances and efficiencies are given. The original conceptual cycle is described in BNL-12319-R. (D.L.C.)

43953 (EUR-4039) EVALUATION OF MAGNETOCALORIC CONVERTERS. Donea, J.; Lanza, F.; Van der Voort, E. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). July 1968. 56p. Dep.

Mechanical power can be produced by cycling thermally a ferromagnetic suspension (ferrofluid) in the presence of a magnetic field through a range of temperatures such that its magnetization changes appreciably. Appropriate ferrofluids and cycles to make this form of power practical are reviewed and evaluation is made of their practical efficiencies and specific power. Choice is made of a practical cycle for which a preliminary dimensioning and a draft design are presented. (auth)

43954 IMPROVEMENTS IN OR RELATING TO MAGNETOHYDRODYNAMIC APPARATUS. Wallis, Peter Trevor; Gaunt, Ralph George (to Central Electricity Generating Board). British Patent 1,121,061. July 24, 1968. Filed Sept. 14, 1965.

This wall for a duct for magnetohydrodynamic apparatus comprises a plurality of metal modules of hollow form open on the face towards the outer side of the duct wall. The modules are assembled with insulating material between them and with insulating elements each extending across at least some of the modules. The insulating elements and modules are shaped to engage one another, leaving a coolant channel between the insulating element and module leading from the corresponding channel of an adjacent module over the inside face of the module surface facing the duct to the coolant channel of another adjacent module. (M.H.R.)

43955 DUCT FOR MAGNETOHYDRODYNAMIC DEVICES. Powers, William E. Jr.; Novack, Martin E.; Blackburn, Philip R. (to Avco Corp.). U. S. Patent 3,387,150. June 4, 1968. Filed Nov. 16, 1964.

In an MHD device having a duct for conveying an electrically conductive gas through a magnetic field, a plurality of oppositely disposed electrodes are in communication with this gas for conducting electricity generated by the movement of the gas relative to the magnetic field. This device is characterized by resultant electric field gradients at any given point within the duct comprising the vector addition of a first electric field gradient normal to the direction of gas flow at the given point and a second electric field gradient parallel to the direction of gas flow at this given point. The device includes a plurality of heat-resistant, nonmagnetic, and electrically conductive plates disposed in side-by-side relationship defining at least part of the duct. The plates each have a central opening which surrounds the longitudinal axis of said duct and a passage for receiving a coolant adjacent to the central opening. At least some of the plates intersect a plurality of the resultant electric field gradients and are at least approximately normal to the resultant field gradients at the points of intersection. Means are included for fixedly maintaining said plates in electrically insulated and side-by-side relationship. (M.H.R.)

43956 ONCE-THROUGH LIQUID METAL PISTON MHD GENERATOR. Powell, J. R. Jr. (to United States Atomic Energy Commission). U. S. Patent 3,399,315. Aug. 27, 1968.

This patent relates to a liquid-metal magnetohydrodynamic generator in which slugs of liquid metal are accelerated by pressurized vapor of the same metal. A magnetic field is established through which the slugs are accelerated to cut lines of force and electrodes are present to establish continuous electrical contact through the slugs to carry away an electric current. (AEC)

43957 IMPROVEMENTS IN AND RELATING TO APPARATUS FOR THE DIRECT GENERATION OF ELECTRICITY. Morrison, William (to International Research and Development Co., Ltd.). British Patent 1,124,361. Aug. 21, 1968. Filed Feb. 12, 1965.

A magnetoplasmadynamic (MPD) generator is described in which the duct has improved high-temperature performance, resulting in increased efficiency. The duct wall is permeable, and a cooling fluid is passed over the outer surface of the permeable wall at high pressure, so that some of the fluid passes through the wall, and the remainder is fed to the upstream end of the duct to form part of the working fluid. Thus, the inner surfaces of the duct are cooled by a "sweat" cooling process. The duct wall may be a porous glass ceramic material, such as "Cercor," and apertures or channels may be provided for additional permeability. If the cooling fluid is the same as the working fluid, the cooling system acts as a preheater. The cooling fluid may be a liquid which is vaporized during its passage through the wall. A flow diagram is presented for a MPD generating plant in which cesium-seeded helium is used. (D.L.C.)

43958 DIRECT ENERGY CONVERSION. Soo, S. L. Englewood Cliffs, N. J., Prentice-Hall, Inc., 1968. 343p. $12.50.

Basic concepts of direct energy conversion are covered. As much concern is devoted to the similarities as to the differences in details of various devices. Generalization includes representation and analysis in terms of transport of charge carriers and energy level diagrams, as well as classification based on irreversible thermodynamics. Specific devices and their fundamentals are treated as engineering cases. Criteria for comparison, selection, and design are given from considerations of physical limitations, missions, and systems. (M.H.R.)

43959 HIGH VOLTAGE GAMMA–ELECTRIC CELL OPERATION. Sampson, H. T.; Miley, G. H. (Univ. of Illinois, Urbana). Nucl. Appl., 5: 145-55(Sept. 1968).

Stable voltage outputs exceeding 10 kV have been obtained with two multicollector gamma–electric cell designs using epoxy or polystyrene dielectric. Short-circuit currents ranged from 3 to 5×10^{-17} A/cm^2 R/hr. Voltage breakdown and erratic output, observed in certain cell designs and ranges of gamma dose rates, are attributed to radiation effects including induced polarization of the dielectric. A theory for high-voltage operation, involving both the collection of Compton electrons and leakage currents, is developed. (auth)

43960 EXPERIMENTAL INVESTIGATION OF CESIUM THERMIONIC CONVERTER WITH TUNGSTEN CATHODE. Kondrat'ev, F. V.; Sinyutin, G. V. At. Energ. (USSR), 24: 553-7(June 1968). (In Russian).

Experimental data on the operation of a cesium converter with vacuum-melted tungsten cathode for different values of cathode temperatures, cesium vapor pressures, and size of interelectrode gap are presented. At cathode temperatures up to 1800°C the tungsten cathode provides useful powers of about 5 to 8 W/cm^2 in optimal conditions. The comparison of experimental data with the Rasor phenomenological theory of the arc regime is made and it is concluded that the theory is experimentally proved for the most interesting regimes. (auth)

43961 CALCULATION OF LOSSES AND THE EFFICIENCY COEFFICIENT FOR THE PLANE CHANNEL OF LIQUID-METAL-CONDUCTING MHD MACHINES. Duganov, V. V.; Kovner, D. S. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 4, 83-8(1967). (In Russian).

The efficiency of an infinite plane channel with a transverse magnetic field is calculated as the ratio of the useful energy over the expended energy. The momentum integral method is used to calculate the viscous and hydraulic loss in the channel as well as the Joule heating. Universal expressions are then obtained for the generator efficiency operating both in the pump and generator modes, either for laminar or turbulent flows. For the viscous incompressible flow of a conducting fluid in an E X H field, it is found that a knowledge of the load coefficient and the hydraulic loss coefficient for the no-load operation is sufficient for estimating the various losses in the channel. A similar conclusion holds for the with-load operation at the same values of the Hartmann and Reynolds numbers. (ATD)

43962 NATIONAL SPACE ELECTRIC POWER PROGRAM: IS IT ADEQUATE. Gordon, Robert (Aerojet-General Corp., Azusa, Calif.). Astronaut. Aeronaut., 6: 62-9(June 1968).

The joint national program for space electric power of NASA, AEC, and DOD is outlined. Programs largely supported by the AEC include the thermoelectric and thermionic systems, as well as all systems utilizing nuclear-energy sources. The technologies involved include solar, chemical, radioisotope, and reactor sources and photovoltaic, thermoelectric, thermionic, Brayton, and Rankine power-conversion modes. Effort is being expended in many different areas including magnetohydrodynamics (MHD). The technology readiness dates are shown on a chart. Another chart provides data on the goals for isotopic space power. The apparent gap between the 50-W SNAP-27 and the 500-W SNAP-29 is covered by development of a 250-W unit under the isotope-improved thermoelectric category. The chart also shows the FY 1968 programs for nuclear-reactor space power systems. The gas-cooled reactor for a Brayton system and the liquid-metal reactor for a potassium-Rankine system are designed for operation at very high temperatures, i.e., above 2000°F. Thus there appears to be no work underway aimed at development of reactor capability between 2000°F and the 1300°F operating temperature of SNAP-8. This large increase in capability in a single step is quite ambitious. The AEC space power budget is itemized. Total annual expenditures for space power by all agencies and organizations are probably between \$150 and \$200 million, and ~50% of these funds are allocated to nuclear systems. The nuclear effort is approximately evenly divided between radioisotopes and reactors. (BBB)

Fluid Physics

Refer also to abstracts 43692, 43961, and 44380.

43963 "LIMITING CIRCLES" OF ONE-DIMENSIONAL MHD CHANNEL FLOWS. Wu, Ying-chu Lin (Univ. of Tennessee Space Inst., Tullahoma). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 1581-3(Aug. 1968).

It is found that, in a constant-area channel, the supersonic flow can only be accelerated when it operates at an efficiency higher than $(\gamma - 1)/\gamma$ inside the limiting circle while the subsonic flow has to be outside of this limiting circle. Other interesting regions due to MHD effects are also discussed. (TSS)

43964 DISSIPATIVE MAGNETOGASDYNAMIC FLOW. Salathe, Eric P.; Sirovich, Lawrence (Brown Univ., Providence). J. Fluid Mech., 33: 361-77(Aug. 12, 1968).

An analysis of the structure of the wakes and waves in steady compressible magnetohydrodynamics is presented. No restriction is made on the equation of state of the gas or on the ratios of the various dissipative parameters. An asymptotic solution is obtained which furnishes directly the flow far from a body and which may be used in the construction of the entire flow field. The non-dissipative solutions are obtained as a non-uniform limit for vanishing dissipation; no matter how small the dissipation, it is possible to proceed far enough from the origin that the flow is essentially dissipative. For non-aligned fields the wave pattern consists of a downstream wake and either two or four standing waves, depending on the flow regime. For aligned fields two of these waves become wakes, so that the wake is a superposition of three structured layers, with either all downstream or two downstream and one upstream. It is found that the non-dissipative limit of the wake is non-unique for the aligned fields case. Different limits are obtained, depending on how the various dissipative parameters vanish. (auth)

43965 HYDROMAGNETIC SURFACE WAVES WITH ALTERNATING MAGNETIC FIELDS. Schaffer, Michael J. (Massachusetts Inst. of Tech., Cambridge). J. Fluid Mech., 33: 337-51 (Aug. 12, 1968).

Hydromagnetic surface waves propagating on the surface of a finitely conducting fluid were studied experimentally and theoretically. An alternating magnetic field was used, so that the field was largely excluded from the bulk of the fluid. Thus, the magnetic damping of the waves was negligible, and the perfectly conducting dc case was simulated. The effects of a finite electromagnetic skin depth, δ, are included in the calculation of the theoretical wave dispersion relation. It is predicted that as δ is increased and becomes comparable to the wavelength of the surface wave, the effect of the magnetic field on the fluid motion is decreased. This prediction was confirmed experimentally. (auth)

43966 OSCILLATIONS IN AN MPD ACCELERATOR. Malliaris, A. C. (Avco Corp., Wilmington, Mass.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 1575-7(Aug. 1968).

Experiments were conducted to probe the apparently different behavior of the current distribution for accelerator currents ranging from 200 to 2,000 amps and with values of the applied B field between 0 and 2,500 gauss. (TSS)

43967 STABILITY AND SLANTING OF THE ELECTRIC ARC IN A THERMIONIC RAIL ACCELERATOR. Bond, Charles E.; Potillo, Robert W. (Univ. of Illinois, Urbana). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 1565-7(Aug. 1968).

It is possible to obtain a stable convective electric arc with the thermionic rail accelerator. The stable supersonic arc column in the thermionic rail accelerator with a uniform external magnetic field slants across the electric field at an angle such that the component of arc velocity normal to the column is near the speed of sound for the undisturbed gas, in excellent agreement with wind-tunnel data despite the nonuniformity of the magnetic field in the wind-tunnel experiments. With a thermionic cathode, the direction of slant is opposite to the Hall direction. The observed Mach number of the stable 220-amp convective arc can be approximated by the following relation: $M = 5.7\ B^{0.70}/p^{0.54}$, where B is the magnetic induction in kilogauss and p is the ambient pressure in torr. With the thermionic rail accelerator, it is possible to produce stable convective arcs of considerable length; in the present experiment, the interelectrode gap was varied up to 7 cm. (auth)

43968 SLOW STEADY FLOW OF A CONDUCTING LIQUID AT HIGH HARTMANN NUMBERS. Kulikovskii, A. G. Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza, No. 2, 3-10(Mar.-Apr. 1968). (In Russian).

The slow steady flow of conducting liquids at high Hartmann numbers and low magnetic Reynold's numbers in an inhomogeneous magnetic field was examined, considering the boundary conditions that must be satisfied at the layers near the walls and the special features in the core of the streams. Previous results concerning flow in a homogeneous magnetic field were generalized for any arbitrarily chosen magnetic field. A precise solution was obtained for the flow in any type of tube within an inhomogeneous field. As a special case, the flow of a conducting liquid with straight stream lines in a tube with an arbitrarily chosen cross section within an inhomogeneous magnetic field at high Hartmann numbers was more closely studied. In this case, the inertia forces are exactly zero, and the solution has the same appearance at any magnetic Reynold's number. (TTT)

43969 STUDY OF THE STRUCTURE OF SUPERSONIC STREAM OF IONIZED ARGON MOVING IN A TRANSVERSE MAGNETIC FIELD DURING INDUCED EMF MEASUREMENTS. Zaitsev, S. G.; Lazareva, E. V.; Chebotareva, E. I. Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza, No. 2, 87-91(Mar.-Apr. 1968). (In Russian).

A shock tube was used to determine the induced emf while studying the propagation of argon gas ionized by shock wave in a transverse magnetic field. The last portion of the tube was used for the measurements. The magnetic field was created by the discharge of a condenser battery in the coils of a pulse magnet; a synchronizing mechanism ensured that the magnetic field was at its maximum when the ionized gas passed through the region of interaction. The minimum values of load resistance corresponding to the maximum values of the current through the plasma were determined by means of copper busbars; the inductive resistance did not exceed 10^{-2} ohm. The process was studied by recording the specific radiation and by means of piezoelectric pressure transducers, scanning the obtained interferograms. A new scheme was proposed for the initial stage of the shock wave through the ionized gas passing through a transverse magnetic field. (TTT)

43970 EXPERIMENTAL STUDIES ON THE INFLUENCE OF A TRANSVERSE MAGNETIC FIELD ON THE CONVECTIVE HEAT EXCHANGE DURING THE TURBULENT FLOW OF AN ELECTRICALLY CONDUCTING LIQUID IN A CHANNEL. Kovner, D. S.; Krasil'nikov, E. Yu.; Nikolaenko, V. S.; Panevin, I. G. Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza, No. 2, 91-4(Mar.-Apr. 1968). (In Russian).

The nature of the flow of an electrically conducting liquid is greatly affected by the application of an external electric field. In the case of turbulent flow, the magnetic field interacts with the averaged flow and the pulsing motion, resulting in the first case in the compression of the mean velocity profile (Hartmann effect), and in the second case, in the suppression of turbulent velocity pulses. Under conditions of laminar flow, the Hartmann effect intensifies somewhat the heat exchange. This problem was investigated on a molten-gallium-filled loop, and kept at a maximum temperature of 70°C. The rectangular copper pipe was heated by means of nonmagnetic, stainless steel, dc heating elements. It was found that the external magnetic field affects greatly the convective heat exchange; the intensity of the heat exchange increases with increasing Hartmann number. However, if the Reynold's number increases, the ratio of inertial forces in the magnetohydrodynamic stream will also increase, as a result of which the effect of the magnetic field on the pulsing movement and on the convective heat exchange will decrease. Under such conditions, the role of heat conduction becomes more important in the heat exchange process. (TTT)

43971 INVESTIGATION OF THE PHYSICAL PICTURE OF THE DISCHARGE BETWEEN COLD ELECTRODES IN A SUPERSONIC PLASMA JET WITH ADMIXTURES. Alferov, V. I.; Ustinov, Yu. S. Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza, No. 2, 95-9(Mar.-Apr. 1968). (In Russian).

As a result of the cooling of the electrodes in a magnetohydrodynamic device, the temperature of the gas jet containing additives is much lower near the electrodes than in the center of the current. Under these conditions, the layers adjoining the electrodes become practically nonconducting. This problem was studied by examining the passage of current through the boundary layers of the electrodes in a supersonic plasma jet. The mechanism could involve the formation of an electric arc in the boundary layer, creating an incandescent spot with thermoelectric emission, creation of high-tension electric fields in the thin plasma layer, or conductivity of positively charged ions. The experiments were carried out in an electrically heated aerodynamic tube containing air with KBr admixture, and heated to 1900 to 3000°C. The threshold tension was determined and the phenomenon was studied by means of motion pictures taken at about 1500 frames/second. The pictures indicated that localized, sharply contracted channels were created at the cold electrode and the current passed through the boundary layer in the form of an arc. (TTT)

43972 HEAT TRANSFER IN CROSSED-FIELDS MHD COUETTE FLOW. Soundalgekar, V. M. (Indian Inst. of Tech., Bombay). Indian J. Pure Appl. Phys., 6: 326-7(June 1968).

A study of heat transfer in crossed-field MHD Couette flow for an incompressible fluid is presented. The wall temperature is assumed to vary linearly in the direction of flow. Closed form solutions for temperature θ, Nusselt number Nu, and mean mixed temperature T_{im} are derived. The effects of M (the Hartmann number), K (the electric field parameter), PrRS (a product of Prandtl number, Reynolds number and a nondimensional number) on θ, Nu, and T_{im} are presented. It is observed that the symmetrical form of the temperature profiles is distorted by the application of the electric field. Nu decreases with an increase in K, for all values of M, but an increase in K leads to an increase in mean mixed temperature T_{im}. (auth)

43973 OSNOVY TEORII I PROEKTIROVANIYA LINEINYKH INDUKTSIONNYKH NASOSOV DLYA ZHIDKIKH METALLOV. (Basic Theory and Design of Linear Liquid Metal Induction Pumps). Okhremenko, N. M. Moscow, Atomizdat, 1968. 396p.

The theory of electromagnetic phenomena and various high-energy induction magnetohydrodynamic generators are discussed. Magnetohydrodynamics for laminar and turbulent liquid metal flow in plane channels of induction pumps with a moving magnetic field are analyzed. Calculations of optimum dimensions for various types of induction pumps are included. 178 references. (R.V.J.)

43974 A REVIEW OF BASIC STUDIES ON MHD POWER GENERATION FOR NUCLEAR APPLICATIONS. Nippon Genshiryoku Gakkaishi, 10: 390-6(1968). (In Japanese).

A summary review is presented on the activities of the "Special Committee on Nuclear MHD Power Generation" during the two years from its establishment in October 1965 to September 1967. The subjects include MHD plasma diagnostics, problems in generator channels, generators utilizing nonequilibrium ionization, experiments with shock tubes, materials for the closed-cycle technology, liquid-metal MHD generators, and the prospects for nuclear-powered MHD power plants. It is emphasized that further studies are needed for covering the details of these subjects, especially for a better understanding of the basic phenomena of nonequilibrium MHD plasmas and related technology, in order to further promote progress in the activities in this field in Japan. (auth)

43975 ON GENERALIZED MHD COUETTE FLOW WITH HEAT TRANSFER. Soundalgekar, V. M. (Indian Inst. of Tech., Bombay). Proc. Nat. Inst. Sci. India, Part A, 33: 264-75(Nov. 1967).

An investigation of combined influence of electric and magnetic fields on generalized MHD Couette flow was carried out. A solution for the flow field and temperature field is obtained in a closed form by assuming an incompressible fluid of constant properties and one-dimensional flow. Calculations are presented which show the influence of RP_x (product of Reynolds number and pressure gradient), M (Hartmann number) and K (electric field factor) on the flow. In particular, if in addition to a magnetic field, an electric field is applied, it is observed that (i) separation of fluid at the stationary plate, caused by pressure-induced flow on simple shear flow, may be avoided and (ii) the force to move the upper plate is less, the greater K. Results are also compared for plane and generalized Couette flow in open- and short-circuited cases. (auth)

43976 MHD CHANNEL FLOW OF AN ELECTRICALLY CONDUCTING, INCOMPRESSIBLE, VISCOUS, RAREFIED GAS AS AFFECTED BY WALL ELECTRICAL CONDUCTANCES. Soundalgekar, V. M. (Indian Inst. of Tech., Bombay). Proc. Nat. Inst. Sci. India, Part A, 33: 276-80(Nov. 1967).

A study is presented here of the flow of an electrically conducting, incompressible, viscous, rarefied gas between parallel conducting walls under a transversely applied magnetic field with slip-velocity conditions. It is observed that the velocity profiles, slip-velocity, center-line velocity and mass flow rate depend on the Hartmann number M, the sum of the electrical conductance ratios $\phi_1 + \phi_2$, and the slip-velocity coefficient λ. The shear stress coefficient is unaffected by λ and is affected only by $\phi_1 + \phi_2$ and M. (auth)

43977 STABILITY OF THE INTERFACE BETWEEN TWO FLUIDS IN RELATIVE MOTION. Gerwin, Richard A. (Boeing Scientific Research Labs., Seattle, Wash.). Rev. Mod. Phys., 40: 652-8(July 1968).

Some basic properties of the Kelvin–Helmholtz instability are reviewed, and some papers dealing with various refinements of this phenomenon are discussed. (auth)

43978 FORCED OSCILLATIONS IN A MAGNETIC INDUCTION FIELD OF A FLOWING LIQUID IN A SMALL CHANNEL OF RECTANGULAR CROSS SECTION, IN THE CASE WHERE THE MEAN VALUE OF THE CURRENTS INDUCED NORMAL TO THE FLOW CAN NOT BE NEGLECTED. Poirier, Yves; Vives, Charles (Faculte des Sciences de Luminy, Marseille). Compt. Rend., Ser. A and B., 266: 1166-9(June 10, 1968). (In French).

An approximate theoretical study is made of forced oscillatory motion of a viscous and electroconducting liquid evolving perpendicularly to a uniform magnetic induction field in a very long channel, having a rectangular section of very small thickness relative to the other dimension. The problem is studied in the case where this channel is connected externally to an ohmic resistance of arbitrary value. Formulas give expressions for the local velocity and the mean velocity of the liquid as a function of several parameters. Curves illustrating the numerical results are obtained for several values of these parameters. (tr-auth)

43979 MAGNETIC FIELD INFLUENCE ON THE TAYLOR INSTABILITY DEVELOPMENT COMPRESSIBLE CONDUCTIVE FLUIDS. Nikolaev, Yu. M. (Scientific-Research Inst. of Nuclear Physics, Moscow). Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 5, 80-7(Sept.-Oct. 1967). (In Russian).

Magnetic field effects on the development of gravitational instability at the interface border of two compressible perfectly conducting liquids were investigated. Characteristic equations obtained determined the growth of the amplitude perturbation as a function of the physical parameters of the media. It is shown that a magnetic field exerts a stabilizing and slowing down effect on the perturbation in nonstationary conditions. The results are in good agreement with published literature. (R.V.J.)

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Refer also to abstracts 43723, 43725, 43765, and 44305.

43980 (D-1-82-0713) CYCLOTRON RESONANCE AMPLIFICATION OF WHISTLERS IN THE MAGNETOSPHERE. Liemohn, Harold B. (Boeing Scientific Research Labs., Seattle, Wash. Geoastrophysics Lab.). Apr. 1968. 26p. Dep.

Electromagnetic waves and charged particles in the magnetosphere may exchange energy through the cyclotron resonance interaction. If the nonthermal particles have an anisotropic pitch angle distribution, vlf and ulf signals may be amplified over well-defined broad bands of frequencies. An analytic solution of the dispersion equation is obtained for a particular anisotropic distribution which simulates magnetospheric conditions, and the instability is found to be unique and convective. Frequency spectra of the net power transfer along whistler paths are presented for a class of distributions which are thought to be typical of quiescent conditions in the magnetosphere. Finally, the theory is applied to experimental amplitude measurements of a vlf whistler event to illustrate its potential for estimating the phase space distribution of nonthermal particles in the magnetosphere. (auth)

43981 SOME FEATURES OF GEOMAGNETIC MICROPULSATIONS OBSERVED DURING THE RECENT QUIET SOLAR YEARS, WITH PARTICULAR REFERENCE TO DATA OBTAINED AT THE NEAR CONJUGATE STATIONS OF GREAT WHALE RIVER AND BYRD. Jacobs, J. A.; Wright, C. S. (Univ. of British Columbia, Vancouver). Geophys. J. Roy. Astron. Soc., 15: 53-67(June 1968).

A description is given of some of the salient features of the early history of geomagnetic micropulsations since 1918, which were responsible for the interest in this field and the type of equipment still in use at many ground stations. The more recent work in this field is also reviewed. The importance of observations at polar stations is touched upon in relation to similar observations at mid-latitude stations during the recent years of quiet solar conditions when the 27-day solar rotation period was often prominent. This period was especially well-marked at the two near-conjugate stations, Byrd and Great Whale River, in the southern and northern auroral zones. The correlation between these two stations is only briefly mentioned, since it will be the subject of a separate report. The paper concludes with a brief discussion of the very important results of satellite observations. Better co-ordination of satellite data with data received on the ground is needed and internationally planned operations of land stations for the coming years of greater solar activity are necessary. (auth)(UK)

43982 WESTWARD DRIFT AND GEOMAGNETIC SECULAR CHANGE. Vestine, E. H.; Kahle, Anne B. (Rand Corp., Santa Monica, Calif.). Geophys. J. Roy. Astron. Soc., 15: 29-37 (June 1968).

Short-term fluctuations in the length of the day over the order of a decade are discussed in relation to fluctuations in westward drift of the outer part of the Earth's core. Decreases in the Earth's rotation rate noted near 1910 and 1965 are shown to be correlated with decreases in westward drift of the Earth's magnetic eccentric dipole, which probably originates fairly deep within the Earth's core. If the outer 200-km thickness of the core moves approximately as does the eccentric dipole field, the changes in angular momentum implied for this part can explain the observed changes in the length of the astronomical second, on the basis of conservation of angular momentum. Other estimates of westward drift in the core based on higher-degree harmonic terms give a lower westward drift, and also seem to show less precision in the estimates of flow in the core. These discrepancies are unexplained. (auth)(UK)

43983 THE CAUSES AND USES OF GEOMAGNETIC DISTURBANCE INDEX Kp. Piddington, J. H. (Commonwealth Scientific and Industrial Research Organization, Chippendale, New South Wales). Geophys. J. Roy. Astron. Soc., 15: 39-52(June 1968).

The planetary indices of magnetic activity Kp and ap are widely regarded as overall measures of solar wind–magnetosphere interaction and are used in correlation studies of interplanetary and solar phenomena. For three levels of activity, quiet, average, and storm, the components of magnetic fluctuation and the current systems responsible are isolated and their contributions to Kp assessed. It is concluded that Kp does not provide an adequate index of overall activity and should be used with care in correlation studies. The main contribution to Kp is from ionospheric currents caused by enhanced activity in the geomagnetic tail, so that Kp is a measure of tail activity, perhaps accelerated field annihilation caused by "flapping." There are three important components of magnetic disturbance which make little or no contribution to Kp; there may be substantial solar wind interaction and current systems where Kp = 0. Such current systems are the Chapman–Ferraro current (measuring wind pressure), a polar cap current system probably measuring frictional interaction, and rapidly fluctuating currents around the auroral oval. The introduction of activity indices additional to Kp seems desirable to provide a full history of overall geomagnetic activity and for use in correlation studies. If a single index is needed then Kp could be extended downward to negative values. The possible significance of some solar wind correlations made using Kp are discussed briefly. (auth)(UK)

43984 DEPENDENCE ON GEOMAGNETIC ACTIVITY OF MAGNETIC PULSATION FREQUENCY OF pc-3 AND pc-4 RANGES. Nagata, T. (Univ. of Pittsburgh); Fukunishi, H. Geophys. J. Roy. Astron. Soc., 15: 69-78(June 1968).

Frequency spectra of magnetic pulsations of frequency range from 5 to 100 mHz observed at temperate latitudes consist of two dominant frequency bands, 15 mHz and 35 mHz, in their representative average values. The frequency of both bands increases with an increase of geomagnetic activity represented by $\overline{Kp}$ or ΣKp. The time of occurrence of maximum frequency in both bands in their regular daily variation of frequency advances toward the dawn side with an increase of Kp. It seems likely that the resonators for the 15- and 35-mHz bands can be identified respectively as a standing Alfvén wave along the field line on the plasmapause and a standing modified Alfvén wave between the plasmapause and the ionosphere. The increase in frequency, and the dawnward shift of maximum frequency time, can then be ascribed to a contraction and a deformation, respectively, of the plasmapause caused by an intensified solar wind accompanied by an increase in Kp index. (auth)(UK)

43985 THEORETICAL MAGNETOGRAMS FOR ssc WHEN THE OCEAN EFFECT IS CONSIDERED. Rikitake, T. (Tokyo Univ.). Geophys. J. Roy. Astron. Soc., 15: 79-90(June 1968).

Electromagnetic induction by a hypothetical ssc in an Earth model consisting of a nonuniform surface sheet representing the oceans and an inner uniform spherical conductor is studied. Expected magnetograms for a number of observatories are then formed. In general, agreement between the expected and observed magnetograms is poor. It is concluded that most of such disagreements are caused by local irregularities in the electrical conductivity which cannot be described by the large-scale conductivity contrast represented by the present model. (auth)(UK)

43986 Sq AND L CURRENT SYSTEMS IN THE IONOSPHERE. Matsushita, S. (Univ. of Colorado, Boulder). Geophys. J. Roy. Astron. Soc., 15: 109-25(June 1968).

Electric current systems in the ionosphere caused by the Sun and the Moon on geomagnetically quiet days have been deduced from geomagnetic data by various workers. These current systems are briefly reviewed and remaining questions and ways to solve them are discussed. (auth)(UK)

43987 IONOSPHERIC CONDUCTIVITY AND Sq VARIATIONS. Price, A. T. (Univ. of Exeter, Eng.). Geophys. J. Roy. Astron. Soc., 15: 93-102(June 1968).

The applicability of the layer conductivities in the two-dimensional treatment of the dynamo theory of Sq is examined. Calculations with a simple three-dimensional model suggest that the currents arising from wind-induced electromotive forces are nearly horizontal throughout the dynamo layer, so that the two-dimensional equations involving the layer conductivities can be used. The assumption, almost universally made in theoretical discussions about Sq, that the horizontal current density is non-divergent and that consequently a current function can be found, is, however, shown to be quite untrue. Hence a major revision of much theoretical work on Sq appears necessary. (auth)(UK)

43988 AUTOMATIC CALCULATION OF DAILY IONOSPHERIC CURRENT SYSTEMS. Stone, D. J. (Univ. of Exeter, Eng.). Geophys. J. Roy. Astron. Soc., 15: 127-36(June 1968).

The separation of mean hourly values of the field components determined at magnetic observatories into the constituent fields and associated current systems involves a considerable amount of computation. For many purposes it would be extremely valuable to perform this separation daily for several epochs of Universal Time. This is only possible if the separation is performed automatically by digital computer. The steps involved in an automatic separation are presented. These are (1) the recognition of the different types of magnetic variation and the separation of the fields, (2) the interpolation of these fields in accordance with precisely defined assumptions about their distribution, (3) the further processing of each of these fields, for example, the calculation of representative current systems, (4) the presentation of the results in a satisfactory manner, for example, the automatic plotting of current charts. The general principles involved in writing a computer program to perform this separation and calculation of current systems are discussed. (auth)(UK)

43989 ION DRAG WITH ELECTRODYNAMIC DRIFT: COMPUTER EXPERIMENT FOR THE F2 LAYER. Kendall, P. C.; Windle, D. W. (Univ. of Sheffield, Eng.). Geophys. J. Roy. Astron. Soc., 15: 147-56(June 1968).

The model F2 layer considered is one in which the ions move under the influence of electrodynamic drift and simultaneously diffuse along the geomagnetic field lines. Both these motions are assumed to set the neutral air moving horizontally. The problem is made soluble by assuming that the ratio b of the horizontal velocity of the neutral air to the horizontal velocity of the ions is constant. Thus $b = 0$ corresponds to a stationary neutral atmosphere, while $b = 1$ corresponds to the case of fully matched horizontal velocities. Allowance is made for curvature and convergence of the (dipole) magnetic field lines, and for variations of electron density with latitude and height. The model layer is isothermal, and is made symmetrical about the equator by assuming that the geomagnetic dipole axis coincides with the Earth's axis of rotation. Equilibrium is assumed; thus the calculations hold only for some fixed time in the early or middle afternoon. The results show that the value chosen for b chiefly affects the overall magnitude, rather than the distribution, of electron density. Electrodynamic drift is much more important than ion-drag in determining the distribution. The calculations support others made recently, which confirm Martyn's theory that electrodynamic lifting is a major feature of the low latitude ionospheric F2 layer. The motion of the neutral air in this particular model does have some effect. The results are discussed in relation to other theoretical and experimental work. (auth)(UK)

43990 THERMAL DIFFUSION AND MULTIPLY CHARGED ATOMS IN THE MAGNETOSPHERE. Nakada, M. P. (Goddard Space Flight Center, Greenbelt, Md.); Singer, S. F. Geophys. J. Roy. Astron. Soc., 15: 163-81(June 1968).

Chapman indicates the importance of thermal diffusion effects in plasmas. When applied to the Earth's magnetosphere, thermal diffusion, in addition to electrostatic force effects, can produce very marked deviations from local thermodynamic equilibrium; therefore it becomes possible for appreciable concentrations of multiply ionized atoms to exist in a low-temperature plasma. The concentration of O^{++}, O^+, He^{++}, and other ions was calculated for a variety of assumptions concerning the thermal gradient and the recombination coefficient. Under some conditions the concentration of O^{++} may dominate at distances of several Earth radii and produce interesting geophysical consequences. (auth)(UK)

43991 ROTATION OF THE LOW-LATITUDE DS FIELD AND WESTWARD DRIFT OF A PARTIAL RING CURRENT. Sugiura, Masahisa (Univ. of Washington, Seattle). Geophys. J. Roy. Astron. Soc., 15: 23-7(June 1968).

The systematic change in the phase of the first harmonic of the low-latitude DS field of magnetic storms determined by Chapman (1952) and Sugiura & Chapman (1960) is interpreted as being due to westward drift of protons in a partial ring current. It is shown that to account for the statistical average phase shift of the DS field the average energy of the protons must be about 10 keV. (auth)(UK)

43992 GROWTH OF THE STORM-TIME RADIATION BELT AND THE MAGNETOSPHERIC SUBSTORM. Akasofu, Syun-ichi (Univ. of Alaska, College). Geophys. J. Roy. Astron. Soc., 15: 7-21(June 1968).

Important features of the radiation belt (or the so-called "ring current") which grows in the magnetosphere during geomagnetic storms are summarized. The growth of the belt was studied in relation to a frequent occurrence of intense magnetospheric substorms (of which manifestations in the polar upper atmosphere are the auroral and polar magnetic substorms). It is concluded that during the magnetospheric substorm, the particles responsible for the storm-time belt are produced locally in the trapping region in the evening sector, but not in the midnight sector. (auth)(UK)

43993 PROGNOSIS OF GEOMAGNETIC PULSATIONS. Vero, Jozsef. Geofiz. Kozlem., 17: 63-70(1968). (In Hungarian).

In the prognosis of the geomagnetic pulsations, within the 11-year sunspot cycle, the yearly, lunar, and the 27-day (corresponding to the Sun's rotation) cycles of the activity can be used. Although these periodicities are not strongly expressed, they give however, especially the 27-day cycle, certain possibilities for prognosis. In the summer of years of great solar activity, the pulsations increase so sharply that no calculations can be made. This prognosis permits the establishment of the best weeks in each 27-day cycle. (tr-auth)

43994 DOUBLE SCATTERING OF THE PLASMA STREAMS IN A BI-THERMAL IONOSPHERE. Liu, V. C.; Hung, R. J. (Univ. of Michigan, Ann Arbor). Planet. Space Sci., 16: 845-62(July 1968).

The plasma streams, emerged from their interactions with large bodies, were studied using the collisionless Boltzmann equation and the Poisson equation. The ambient ionosphere was assumed bithermal, namely $T_e/T_i = \alpha$, a constant. Numerical results were obtained with the ionospheres in thermal equilibrium ($\alpha = 1$) and quasi-equilibrium ($\alpha = 10$) for comparison. The velocity of the moving bodies is much larger than the thermal speed of the ions and much smaller than that of the electrons. Both cases, with and without the presence of a permanent magnetic field, were considered. The magnetic field is aligned with the motion of the bodies. (auth) (UK)

43995 HYDROMAGNETIC WAVE PROPAGATION AND EXCITATION OF SCHUMANN RESONANCES. Abbas, M. (Univ. of Rhode Island, Kingston). Planet. Space Sci., 16: 831-44(July 1968).

The possibility of excitation of the Earth–ionosphere cavity by hydromagnetic waves propagated through the ionosphere was investigated. Propagation through the ionosphere was studied at frequencies near the lowest resonant frequencies of the Earth–ionosphere cavity (7 to 30 c/s) by use of Epstein's method. In this method certain mathematical functions are assumed as layer profiles and the wave equation is transformed into the hypergeometric equation. The analysis is based on macroscopic equations for a partially ionized inhomogeneous plasma embedded in the Earth's magnetic field. It is assumed that hydromagnetic waves are incident from above and propagated parallel to the Earth's magnetic field. Power transmission coefficients were calculated employing complex refractive index profiles which approximate those obtained from available ionospheric data. The transmission coefficients, calculated for various times of day, show that maximum transmission occurs around local midnight and minimum transmission around local noon. The various single particle and instability mechanisms which could possibly lead to generation and amplification of hydromagnetic waves in the ionosphere are briefly discussed. The expected characteristics of electromagnetic noise in the Earth–ionosphere cavity resulting from excitation by hydromagnetic waves and by worldwide thunderstorm activity are discussed. (auth) (UK)

43996 RAY PATHS OF PC 1 WAVES IN THE MAGNETOSPHERE. Kitamura, T.; Jacobs, J. A. (Univ. of British Columbia, Vancouver). Planet. Space Sci., 16: 863-79(July 1968).

Ray paths of Pc 1 waves (in the frequency range 0.2 to 5 c/s) in the magnetosphere ($L \approx 4$ to 6) were calculated for various frequencies and initial wave normal angles assuming a smooth distribution of plasma density. Results show that in almost all cases waves cannot reach the ionosphere, since the wave normal angle becomes very large (approaching 90°) in the vicinity of the bottom of the magnetosphere. Only in a few cases, when the initial wave normal angle is less than about $-50°$, can waves, beginning in the equatorial plane, reach the ionosphere. This result is incompatible with observations; in order to reconcile it, the existence of "proton ducts" along field lines, as has been postulated in whistler investigations, is suggested. (auth) (UK)

43997 DYNAMICS OF THE ZONE OF CORPUSCULAR PRECIPITATIONS. Pudovkin, M. I.; Shumilov, O. I.; Zaitzeva, S. A. (Leningrad State Univ.). Planet. Space Sci., 16: 881-90(July 1968).

Plasma movement in the tail of the magnetosphere during a polar storm is considered on the basis of the data of ground-based observations of aurorae, geomagnetic bays, and riometric absorption. It is shown that auroral radiation moves towards the Earth during a storm; moreover, electrons drift longitudinally around the Earth from west eastwards and protons drift from east westwards. Meanwhile the energy of the particles increases. It is concluded that during a storm there exists in the magnetosphere large scale electric fields of about 10^{-5} V/cm. About $1\frac{1}{2}$ to 2 hr before the commencement of a polar storm in the auroral zone, equatorial observatories register an increase of the H-component of the geomagnetic field by 10 to 15 γ. It is concluded that the diurnal and nocturnal sections of the auroral zone (Khorosheva's ring) are two separate independent zones of corpuscular precipitation. (auth) (UK)

43998 POLAR STORMS AND DEVELOPMENT OF THE DR CURRENTS. Pudovkin, M. I.; Shumilov, O. I.; Zaitzeva, S. A. (Leningrad State Univ.). Planet. Space Sci., 16: 891-8(July 1968).

The connection of the intensity of polar disturbances with the value of the DR variation is considered. It is shown that at the moments of DR-field maxima the intensity of the field DR is proportional to the total energy of the particles entering the upper atmosphere of the Earth. It is suggested that the acceleration of the auroral particles and filling up the DR belt are due to the same process. (auth) (UK)

43999 THERMAL ION STRUCTURE OF THE PLASMASPHERE. Brinton, H. C.; Pickett, R. A.; Taylor, H. A. Jr. (Goddard Space Flight Center, Greenbelt, Md.). Planet. Space Sci., 16: 899-909(July 1968).

The distribution of thermal positive ions of hydrogen and helium in the magnetosphere was determined from OGO-I ion mass spectrometer measurements made between 23 September 1964 and 17 June 1965. The distribution is strongly controlled by the geomagnetic field, its chief feature being a region of toroidal form, the plasmasphere, bounded approximately by the L = 4.5 shell, within which the ion concentration decreases slowly with increasing altitude from an initial value of 3×10^3 ions/cm^3 at 2000 km. At the boundary of this region, which is compressed during periods of high magnetic activity, a sharp decrease in the ion concentration by a factor of ten or more for an altitude increase of less than $1R_E$ is observed, leading to a concentration beyond the boundary of less than 10^2 ions/cm^3. An apparent diurnal expansion in the plasma distribution is centered at 2000 hr. Over most of the altitude range within the plasmasphere the H^+ and He^+ concentrations show a constant ratio of 300/1, indicating departure from simple diffusive equilibrium. Measurements made by an identical spectrometer on OGO-III generally confirm these properties of the plasmasphere. Significant correlation also exists with whistler observations of the magnetospheric thermal electron distribution. Correlation of latitude variations of ion composition measured by the OGO-II spectrometer with the high altitude distributions obtained by OGO's I and III indicate possible ionosphere–magnetosphere coupling. (auth) (UK)

44000 HYDROGEN ION COOLING IN HELIUM GAS. Dalgarno, A. (Harvard Coll. Obervatory, Cambridge, Mass. Smithsonian Astrophysical Observatory, Cambridge, Mass.); Dickinson, A. S. Planet. Space Sci., 16: 911-14(July 1968).

Accurate values are presented of the rates at which a gas of H^+ ions at a temperature T_1 exchanges energy in elastic collisions with a gas of helium atoms at a temperature T_2. The selection of T_1 and T_2 is appropriate to conditions prevailing in the upper atmosphere. (auth) (UK)

44001 EXCITATION OF STABLE AURORAL RED ARCS AT SUB-AURORAL LATITUDES. Walker, James C. G. (Yale Univ., New Haven); Rees, M. H. Planet. Space Sci., 16: 915-28(July 1968).

Excitation of stable auroral red arcs (SARARCs), by an electric field orthogonal to the magnetic field, and by heat conducted downward in the plasma from above 1000 km, was examined. It was found that electric fields in the range 0.1 to 0.2 V m^{-1} would produce the observed luminosity, but would also raise the ion temperatures at low altitudes to 5000°K and higher, and would deposit more than 2.7 ergs cm^{-2} sec^{-1} as heat in the neutral atmosphere above 250 km. On the other hand, downward heat fluxes between 0.048 and 0.24 ergs cm^{-2} sec^{-1} at 1000 km yield electron temperatures sufficiently high to excite SARARCs without causing any effects which conflict with available observations. (auth) (UK)

44002 FAR-ULTRAVIOLET DAY AIRGLOW STUDIES. Fastie, W. G. (John Hopkins Univ., Baltimore). Planet. Space Sci., 16: 929-35(July 1968).

Rocket spectrophotometer measurements of the O I 1304 and H I 1216 (Ly α) day airglow were made in a Javelin rocket from Wallops Island, Virginia, at 1903 GMT on November 5, 1964, with a solar elevation angle of 30°. A greatly improved reduction of the previously reported flight data is given. From 600 to 867 km the Ly α zenith intensity decreased at the rate of 2.1%/100 km, indicating a total layer of 6 optical depths of atomic hydrogen above 100 km. From 230 to 600 km the O I zenith intensity decreased exponentially with a scale height of 75 km. The implications of these data are discussed and related to previous rocket measurements of these features at lower altitudes. (auth) (UK)

44003 POSSIBLE RELATION OF A SPECIFIC IONOSPHERIC EVENT TO SIMULTANEOUS METEOROLOGICAL DATA. Arendt, P. R.; Frisby, E. M. (Army Electronics Command, Fort Monmouth, N. J.). Nature (London), 219: 475-6(Aug. 3, 1968).

The event discussed concerns a sudden change in the structure of amplitude scintillations of radio signals from the S-66 BEC satellite observed at Fort Monmouth during the night of Oct. 31, 1967, during which night and during the following day an unusual complex meteorological pressure system prevailed in the area. The singularity of the observed phenomena does not permit final conclusions. (UK)

44004 IONOSPHERIC PROBES. Majid, Abdul (Pakistan Space and Upper Atmosphere Research Committee, Karachi). J. Natur. Sci. Math., 7: 143-9(Oct. 1967).

Some of the most reliable techniques used for the measurement of different parameters like electron density, temperature and collision frequency in the ionosphere are discussed. The techniques have been used in the MIP experiment, and the results are briefly described here. (auth)

44005 ENERGETIC INTERPRETATION OF THE PLASMAPAUSE. Bouriot, Michel (Faculte des Sciences, Poitiers, France). Compt. Rend., Ser. A and B, 267: 166-8(July 8, 1968). (In French).

The ratio $P = N_i/N_e$ of the electron density existing in the interior and exterior of the plasmapause, in its immediate neighborhood, is calculated for different values of a limit T_l of the electron temperature, which occurs in the propagation of whistlers. The comparison of the results of this calculation with some experimental results leads to a value of T_l near 1 eV. (tr-auth)

44006 STUDIES ON THE FADING OF THE RADIO WAVES RETURNED FROM THE SPORADIC E REGION OF THE IONOSPHERE. Ganguly, Suman; Samanta, Sisutosh (Bose Inst., Calcutta). Indian J. Phys., 41: 908-18(Dec. 1967).

In some of the studies with vertical pulsed transmission, the blanketing type and the q type of E_s have been observed. The wind type of E_s having a quickly varying top frequency has also been found. When a horizontal dipole has been used as the receiving aerial, the fading records of the E_s echoes have occasionally shown a double trace on the moving film for both the first and the second orders of reflection. On rare occasions, an additional trace has also been observed in this region. A tentative explanation of the double or triple trace has been suggested. The selective aerial for the reception of one or the other of the two magneto-ionic components has been used to take fading records of a single downcoming wave from the sporadic E region on the moving film. The statistical distribution of the amplitude has shown that usually at noon hours, both the Rayleigh and the Rice types of distribution occur, whereas during morning, evening, and early night hours, when the reflection is from the E_s region, there have been other types of amplitude distribution. Of these, the most frequent type has shown usually two maxima in the amplitude distribution curve. The double-peak or the so-called M-type distribution suggests the existence of two simultaneous and independent superimposed processes. It is likely that the double peak is associated with the occurrence of a double layer in the sporadic E region. Typical ν_r-distribution curves have also been shown. The rms line-of-sight velocity of the irregularities in the E_s region has been calculated. (auth)

44007 STUDY OF SUBPROTONOSPHERIC WHISTLERS RECEIVED IN EXCEPTIONAL CASES AT GROUND LEVEL AT MEAN LATITUDE. Corcuff, Pierre (Faculte des Sciences, Vienna). Compt. Rend., Ser. A and B, 266: 1249-52(Apr. 29, 1968). (In French).

Subprotonospheric whistlers were observed in exceptional cases at Poitiers at the solar minimum. The propagation track showed that there exists a strong north–south horizontal gradient of the electron density in the ionosphere. (tr-auth)

44008 ELECTRONS OF NATURAL ORIGIN IN THE INNER RADIATION ZONE. Temnyi, V. V. Kosm. Issled., 6: 234-41(Mar.-Apr. 1968). (In Russian).

On the basis of measurements on Kosmos-3 in 1962 and Elektron-1 and Elektron-2 in 1964, the following characteristics of the stationary distribution of electrons of natural origin with energy above 40 keV in the inner radiation zone were obtained: presence of the maximum intensity (2×10^9 electrons/cm^2 sec) in the equatorial plane between L 1.6 and 1.8; dependence of the intensity on the parameters L and B in the drift trajectory with $\underline{h}_{min} > 700$ km and longitude dependence of the intensity on the trajectory with $h_{min} < 700$ km; and the loss rate from the maximum capture range equal to 2×10^{-8} electrons/cm^3 sec. On the basis of a comparison of the electron distribution obtained with 11 measurements of electrons in different satellites and rockets, carried out from 1958 to 1966, conclusions were made on the stability of the intensity of electrons of natural origin in the inner zone during the eleven-year cycle of solar activity. (tr-auth)

44009 INVESTIGATION OF THE STRUCTURE OF TRAJECTORIES BEHIND SPHERICAL MODELS IN CURRENTS OF RAREFIED PLASMAS. Skvortsov, V. V.; Nosachev, L. V. Kosm. Issled., 6: 228-33(Mar.-Apr. 1968). (In Russian).

The structure of the disturbed region behind spherical models of 2 and 6 cm diameter was investigated experimentally under laboratory conditions. The spherical models were placed in currents of rarefied plasma. Data were obtained on the density distribution of the ion current and potential of the electric field in trajectories for these cases. (tr-auth)

44010 SOURCE OF ATMOSPHERIC ELECTRIFICATION. Webb, Willis L. (Atmospheric Sciences Lab., White Sands Missile Range, N. Mex.). J. Geophys. Res., 73: 5061-71(Aug. 15, 1968).

Synoptic rocket exploration of the stratospheric circulation has revealed the presence of hemispheric tidal circulations that are indicated to be in part characterized by systematic vertical motions in low latitudes of the sunlit hemisphere. These vertical motions are powered by meridional oscillations in the stratospheric circulation produced by solar heating of the stratopause region and serve as the energy source of electrical current systems which are postulated to result from an impressed electromotive force produced by charged particle mobility differences in the lower ionosphere as the tidal circulations tend to force these particles across the Earth's magnetic field. These dynamo currents are variable with geometry and time variabilities of the tidal circulations as well as variability in the solar-induced conductivity of the E region. The semiconducting lower atmosphere and highly conducting Earth's surface occupy the near field of the lower side of this current system, with a resulting complex tropospheric electrical structure. Paths of low-impedance electric current along magnetic field lines result in development of currents in the exosphere that are driven and controlled by the electrical structure of the primary dynamo circuit and that exert a control of their own through interaction with the solar wind. The basic physical process providing the required electromotive force for maintenance of the Earth's atmospheric environment electrical structure is thus indicated to center in thermally driven tidal motions in the lower ionosphere, with locally observed structure, such as the fair-weather electric field, thunderstorms, lightning discharges, aurora, airglow, electrojets, and radiation belts, playing supporting roles. (auth)

44011 ELECTRON CONCENTRATION IN IONOSPHERE STUDY BY MEANS OF RADIOSIGNALS EMITTED BY COSMIC SATELLITES. REVIEW. Getmantsev, G. G.; Gringauz, K. I.; Erukhimov, L. M.; Kravtsov, Yu. A.; Mityakov, N. A.; Mityakova, E. E.; Rudakov, V. A.; Rytov, S. M. Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 649-81(1968). (In Russian).

A brief review is given of various characteristics of the ionosphere as transmitted to the Earth by radiotelemetric instruments installed in rockets and satellites. Dispersion measurements and observations based on Faraday effect carried out by vertically launched rockets offer data on the vertical distribution of electron concentration. Data on ionosphere inhomogeneity parameters (height, spectra, and electron concentration fluctuations) obtained by radio scintillation are described. The vertical distribution of electron concentration studied by means of geophysical rockets indicated that the profile N(h) type in the vicinity of the maximum ionization (200 km < h < 500 km) is a function of the solar activity. The ionospheric inhomogeneities causing fluctuation of satellite signals are distributed mainly near the maximum of the F layer. The spectrum of inhomogeneities occupies a range from several hundred meters to several hundred kilometers. The magnitude of electron concentration fluctuations increased with the increased inhomogeneities. Inhomogeneities are the subject of considerable daily and latitudinal changes. Characteristics of the seasonal changes and inhomogeneity parameters depend on the solar cycle and are variable for various latitudes. (R.V.J.)

44012 MEASUREMENTS OF ELECTRON CONTENT ENHANCEMENTS ASSOCIATED WITH MAGNETIC STORMS. Goodman, John M. (Naval Research Lab., Washington, D. C.). Planet. Space Sci., 16: 951-2(July 1968).

During the spring and summer of 1967, vhf transmissions from geostationary satellite ATS-1 were monitored at the Randle Cliff receiving station and, by means of a Faraday rotation analysis, continuous records of the ionospheric electron content were obtained. Observations of electron content enhancement associated with the sudden commencement of two magnetic storms — on May 25, 1967 and June 5, 1967, respectively — are discussed. (UK)

44013 OBSERVATIONS OF THE NIGHT SKY Hα EMISSION LINE. Ingham, M. F. (Oxford Univ.). Mon. Notic. Roy. Astron. Soc., 140: 155-72(1968).

A series of measurements of the emission rate in the Hα line in the spectrum of the night sky was made with a photoelectric spectrometer at the Observatoire de Haute Provence. The observations were made at the zenith and the North Celestial Pole, and care was taken to make proper allowance for the integrated starlight, the zodiacal light and the airglow continuum, the effect of atmospheric absorption and scattering, instrumental polarization, and contamination by galactic sources of Hα. (auth) (UK)

44014 MAGNETOSPHERIC PROCESSES AND RELATED GEOPHYSICAL PHENOMENA. Shabanskii, V. P. Space Sci. Rev., 8: 366-454(July 1968).

Those processes mainly related to the behavior of the low-energy magnetospheric plasma, which nevertheless contains the main mass and the predominant part of the thermal energy, are considered. Attention has been concentrated on those processes which determine geomagnetic phenomena on the surface of the earth. (M.O.W.)

44015 OBSERVATIONS OF THE INTERPLANETARY PLASMA. Axford, W. I. (Univ. of California, San Diego, La Jolla). Space Sci. Rev., 8: 331-65(July 1968).

Observations bearing on the nature and properties of the interplanetary plasma are reviewed, and consideration is given to possible fruitful directions for further work. The observations are classified according as they involve traditional (comet tail, optical, geomagnetic, cosmic ray), radio (solar noise, radar, radio-source scattering and scintillation, space-probe transmission), or direct (space-probe) measurements. A fairly complete set of references up to September 1967 is given for the cases of comet tail, radar, radio-source scattering and scintillation, and space-probe measurements. (auth)

44016 THE REDSHIFTS OF GALAXIES IN THE REMARKABLE CHAIN VV 172. Sargent, Wallace L. W. (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena. Inst. of Theoretical Astronomy, Cambridge, Mass.). Astrophys. J., 153: L135-7(Aug. 1968).

Redshifts were measured for all five galaxies (A, B, C, D, E, going from north to south) in the chain VV 172, Galaxies A, C, D, and E have redshifts near 16,000 km sec^{-1}; however, galaxy B has a redshift of 36,880 km sec^{-1}. It is shown that the excess redshift of 21,000 km sec^{-1} cannot be gravitational in origin. The remaining conventional interpretations are either that galaxy B is a background galaxy or that it has been expelled from the system with a kinetic energy in the range 10^{60} to 10^{62} ergs, about 10×10^{6} years ago. (auth)

44017 IONOSPHERIC PHYSICS: A RECHARGED FIELD. Bowhill, Sidney A. (Univ. of Illinois, Urbana). Astronaut. Aeronaut., 5: 14-17(Apr. 1967).

Examples of the type of problem now most actively investigated in ionospheric research are treated under three headings: Ionospheric radio propagation, properties of the ionospheric plasma, and studies of physical and chemical processes leading to these properties. Electrical conductivity is very strongly affected by the magnetic field of the Earth. A further complication is introduced by the effects of collisions of electrons with the neutral atmosphere. A typical problem from the classical period of ionospheric research is the choice of frequency for radio communication over great distances. The geostationary communication satellite offers a neat solution to this for it may use radio frequencies which are far higher than those which use ionospheric reflection and which consequently are not subject to appreciable ionospheric effects. Photoelectrons are the ultimate source of the thermal ionospheric plasma, but not until they have lost 99% of their energy. The most important part is given up to the thermal electrons, the Coulomb forces from which have a long-distance braking effect on the photoelectrons. The thermal electrons lose heat to the positive ions, which lose it to the neutral atmosphere. Some photoelectrons ejected upwards may reach an altitude where there is no longer effective braking ionization and journey far out into the protonosphere returning to the opposite hemisphere. Effects of these photoelectrons have been detected in the northern winter hemisphere when dawn photoionization occurs at the corresponding point in the southern hemisphere. The rate of the disappearance of electrons in the F2 layer is limited by the availability of oxygen and nitrogen molecules, resulting in a relatively long lifetime for F2-layer ionization. Ionization of nitric oxide is the predominant source of D-layer ionization, because its low ionization potential enables it to be ionized by solar radiation which has escaped absorption at higher altitudes. Effects of the interplanetary plasma radiating from the Sun or the outer boundaries of the Earth's magnetic field can be communicated down field lines and produce ionospheric effects which profoundly modify the chemical equilibrium of the ionosphere. (BBB)

Low-Temperature Physics

Refer also to abstracts 43600, 44231, and 44236.

44018 (ISS-68/16) RESPONSE PROPERTIES OF A BOSE LIQUID: CONNECTION BETWEEN SYMMETRY BREAKDOWN AND MICROSCOPIC DEFINITION OF THE SUPERFLUID DENSITY. de Pasquale, F.; Tabet, E. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). May 17, 1968. 44p. Dep.

The general response properties are investigated of a Bose liquid with condensed phase, both at T = 0°K and at finite temperature. This is accomplished by exploiting the gauge invariance requirement of the current-current correlation functions $K_{\mu\nu}$ with the aid of techniques developed in previous papers. The main result obtained is an explicit microscopic construction of the superfluid density ρ_s. As an example, an approximation derived from the Bogolyubov model is explicitly worked out. Gauge and Galilei symmetry breakdowns are also discussed, showing that in an infinite volume system with long-range correlations, the Galilei relativity principle is satisfied in a very particular way. Some results on the longe-range behavior of correlation functions, first obtained by Schafroth in the special case of a free charged Bose gas, are shown to be valid also for the Bose liquid. (auth)

44019 (IS-T-221) CRITICAL FIELD CURVES FOR SUPERCONDUCTORS WITH MAGNETIC IMPURITIES. Decker, Wayne Reeves (Ames Lab., Iowa). May 1968. Contract W-7405-eng-82. 87p. Dep. CFSTI.

Thesis.

Critical field curves for thorium with a resistivity ratio of 1200 and three dilute gadolinium–thorium solid solutions were measured by a ballistic induction technique from the critical temperature to 0.3°K. The alloys reported here show characteristics of Type-I superconductors. The data for pure thorium are found to agree to within 0.3% with the theory of Bardeen, Cooper, and Schrieffer over the whole temperature range. Abrikosov-Gor'kov critical field curves for superconductors with magnetic impurities are calculated as suggested by Skalski, Betbeder-Matibet, and Weiss. Measurements for the alloys agree with theory to within 0.5% over the entire temperature range. The specific heat jump at the critical temperature as calculated by the last authors is compared with values obtained from experimental data using Rutger's formula. (auth)

44020 (LA-DC-9703) THE THERMAL CONDUCTIVITY OF ^{4}He I NEAR THE λ-LINE AND OF ^{3}He NEAR THE LIQUID-VAPOR CRITICAL POINT. Kerrisk, J. E.; Keller, W. E. (Los Alamos Scientific Lab., N. Mex.). [1968]. Contract W-7405-eng-36. 4p. (CONF-680808-2). Dep. CFSTI.

From Conference on Low Temperature Physics, St. Andrews, Scotland.

Measurements of the coefficient of thermal conductivity, K(T,P), were made for liquid ^{4}He I between 1.77 and 4.0 K, and for fluid ^{3}He between 1.5 and 4.0 K, both at pressures up to 34 atm. A steady state method with a fixed separation parallel plate cell was used. Heat produced electrically in the upper plate passed through the 0.082 cm thick He layer to the lower plate, which was in contact with a ^{4}He bath. The empty cell was calibrated to assess the heat flow through paths other than the He layer. The effects of convection and thermal boundary resistance were determined; including these, the data are considered accurate to ±3%, though the precision is in general better than ±1%. (auth)

44021 (LA-DC-9732) THE DIELECTRIC POLARIZABILITY OF ^{3}He. Kerr, E. C.; Sherman, R. H. (Los Alamos Scientific Lab., N. Mex.). [1967]. Contract W-7405-eng-36. 4p. (CONF-680808-6). Dep. CFSTI.

From Conference on Low Temperature Physics, St. Andrews, Scotland.

A brief description of the experimental apparatus is given. The results are described. (M.O.W.)

44022 (NRL-6711) THE PRODUCTION OF TEMPERATURES BELOW 1°K BY THE ADIABATIC DEMAGNETIZATION OF 50 PERCENT $Ce(PO_3)_3$-$Ba(PO_3)_2$ GLASS. Althouse, Edwin Lewis (Naval Research Lab., Washington, D. C.). July 15, 1968. 45p.

The technique of adiabatic demagnetization, also known as "magnetic cooling," for producing low temperatures has been in existence since 1933. It was the object of this investigation to determine whether cerium metaphosphate glass (specifically 50% by weight $Ce(PO_3)_3-Ba(PO_3)_2$) is a suitable coolant material for adiabatic demagnetization experiments. Cerium glass is not susceptible to dehydration and attack by glycerine (used for thermal contact) as are many of the hydrated salts. In addition, the concentration of magnetic atoms can be varied over a wide range by diluting the magnetic glass $Ce(PO_3)_3$ with the nonmagnetic glass $Ba(PO_3)_2$. The principal results of this investigation are: (a) the 50% $Ce(PO_3)_3-Ba(PO_3)_2$ glass was successfully cooled many times by adiabatic demagnetization, and "magnetic" temperatures as low as 0.0069°K were reached; (b) using a cerium magnesium nitrate paramagnetic salt as a thermometer, absolute temperatures as low as 0.02°K were observed; (c) within experimental error, the measured Curie constant for the cerium glass (density 3.57) agrees with that calculated from the Brillouin function for $J = \frac{1}{2}$ and $1.97 \leq g \leq 2.00$. (auth)

44023 (TID-24510) A SYSTEMATIC EVALUATION OF CRITICAL EXPONENTS FOR THE MEAN FIELD AND ISING MODELS BELOW T_c. Gonzalo, J. A. (Puerto Rico Nuclear Center, Mayaguez). [1968]. Contract AT(40-1)-1833. 12p. Dep. CFSTI.

It is proved that a fundamental "scaling law" defining ratios of critical exponents holds for the mean field and 2-D Ising model, while it is speculated that this type of "scaling law" may also apply for more complex models, such as the 3-D Ising model. This "scaling law" resembles the well-known proposal of Domb and Hunter, suggesting fixed ratios of critical exponents. (TSS)

44024 A POSSIBLE SOURCE OF INSTABILITY IN NIOBIUM ALLOY SUPERCONDUCTORS. Moon, J. R. (Univ. of Nottingham, Eng.). Phil. Mag., 18: 229-36(Aug. 1968).

An assessment was made of the inhomogeneities in niobium alloy superconductive wires which arise from segregation of alloying elements during ingot solidification. In 0.010 in. diameter wire of Nb-25% Zr, striated microstructures were observed, the bands being about 2 μm wide and representing composition variations of about ±2% Zr. The corresponding data for Nb-48% Ti were about 5 μm and ±8% Ti. A model relating flux jumps to periodically banded microstructures is developed. (auth) (UK)

44025 THE PINNING FREQUENCY OF TYPE-II SUPERCONDUCTORS. Gilchrist, J. le G.; Monceau, P. (Centre de Recherches sur les Tres Basses Temperatures, Grenoble, France). Phil. Mag., 18: 237-50(Aug. 1968).

Calorimetric measurements of the surface resistance of niobium and alloy superconductors in the mixed state show at which frequency flux-pinning ceases to be the dominant factor in determining the electromagnetic response. It is found that the band of frequencies in which pinning is important depends very markedly on the metallurgical state of the specimen and may be much smaller than has previously been supposed. A phenomenological model is developed, in the light of which these and other experimental results are discussed. The Hall effect in the mixed state is being studied in the frequency range where pinning is relatively unimportant. (auth) (UK)

44026 PINNING OF FLUX VORTICES IN TYPE-II SUPERCONDUCTORS. Campbell, A. M.; Evetts, J. E.; Dew-Hughes, D. (Cambridge Univ., Eng.). Phil. Mag., 18: 313-43(Aug. 1968).

The superconducting properties of Pb-Bi alloys are reported. Measurements were made on the epsilon phase (a reversible material with $\kappa \simeq 12$) and the eutectic, which is this epsilon phase with pure Bi precipitates. It is shown that the irreversible properties of the eutectic are consistent with the pinning of vortices in a reversible matrix of epsilon phase. The critical state is shown to be the same in measurements of magnetization, transverse critical currents and zero field critical currents, and it is extended to cover a composite ferromagnetic material. Experimentally it was found that the variation of critical current with flux density, microstructure and temperature is given by the expression $J_c = 33\ S_v M(rev.)/B^{1/4}$ amps/sq cm. (S_v is the phase boundary area per unit volume and M(rev.) the magnetization of the matrix). There is strong evidence that the irreversibility is due to pinning at the phase boundaries of precipitates, and it is found that the surface currents observed in the epsilon phase at low fields can be explained by the same mechanism. A theoretical explanation of the results is given by considering the magnetic interaction between vortices and the phase boundary. The attraction of a vortex to its image is shown to provide a pinning force of the above form and the constant of proportionality agrees within an order of magnitude. (auth) (UK)

44027 MAGNETIC SURFACE LEVELS IN THE PRESENCE OF SURFACE SUPERCONDUCTIVITY. Prange, R. E. (New York Univ.). Phys. Lett., 27A: 346-7(Aug. 12, 1968).

Magnetic surface levels are considered in the presence of surface superconductivity. A novel source of quasi-particle damping is noted. (auth)

44028 MEASUREMENTS OF $\kappa_1(t)$ AND $\kappa_2(t)$ IN Ta–Nb ALLOYS. Smith, C. W.; Sanford, E. R.; Rollins, R. W. (Ohio Univ., Athens). Phys. Lett., 27A: 362-3(Aug. 12, 1968).

The temperature dependence of the Ginzburg–Landau parameters κ_1 and κ_2 for several Ta–Nb alloys shows apparent agreement with theory, in contrast to disagreement found in other transition metal alloys. (auth)

44029 THERMAL CONDUCTIVITY OF NIOBIUM–TITANIUM. Dubeck, L.; Setty, K. S. L. (Temple Univ., Philadelphia). Phys. Lett., 27A: 334-5(Aug. 12, 1968).

Phonon conduction predominates in Nb–Ti below 4.2°K; the thermal conductivity is independent of field up to 6000 G. (auth)

44030 PHENOMENOLOGICAL THEORY NEAR CRITICAL POINTS. Wong, V. K. (Ohio State Univ., Columbus). Phys. Lett., 27A: 358-9(Aug. 12, 1968).

Information in the order-parameter correlation function is used to construct a phenomenological theory which agrees with the known critical exponents, includes the effects of large fluctuations, and is valid right up to the critical points. (auth)

44031 THE ELECTROMAGNETIC TRANSPORT COEFFICIENTS OF GAPLESS CLEAN TYPE-II SUPERCONDUCTORS. McLean, F. B.; Houghton, A. (Brown Univ., Providence). Ann. Phys. (N. Y.), 48: 43-71(June 1, 1968).

The response of clean ($l \gg \xi_0$ where l is the electron mean-free path and ξ_0 is the pure superconductor coherence length) type-II superconductors to an external perturbing ac field has been calculated for the case when the applied dc magnetic field is of the order of H_{c_2}, the upper critical field. The method used in the calculation relies on an expansion of the transport coefficients in powers of the average order parameter $\overline{\Delta}(r)$. It is shown that when $k_c l \gg 1$, where $k_c = (2eH)^{1/2}$ is the characteristic wave vector of the vortex lattice when $H \lesssim H_{c_2}$, such expansions converge even if $\omega < \overline{\Delta}$ provided that $(k_c l)^2 \{[H_{c_2}(T) - H]/H_{c_2}\} \ll 1$. Particular attention is paid to a calculation of the attenuation coefficient of longitudinal sound. It is shown that resonant absorption associated with the periodic nature of the flux line lattice is of negligible amplitude. When the discrete lattice of the mixed state is replaced by a continuous distribution function it is found that the calculated attenuation coefficient is consistent with experiment within the regime of validity of the theory. Finally, in the limit of infinite mean-free path, the result previously derived by Cyrot and Maki is recovered. (auth)

44032 APPARATUS FOR REGULATING AT LOW TEMPERATURES. Zobel, W. (to United States Atomic Energy Commission). U. S. Patent 3,398,549. Aug. 27, 1968.

A cryostatic system for reducing the temperature of an environment in which semiconductors or other objects may be examined or operated and for maintaining a selected temperature in the environment for desired periods of time is described. A highly conductive heat transfer element is partially enclosed in a vacuum chamber. The unenclosed portion is submerged in a cryogenic fluid. The vacuum chamber pressure is controlled by a vacuum pumping system connected to the chamber and a gas flow control element which allows small portions of a gas to diffuse therethrough at a rate necessary to provide a given constant pressure. By controlling the pressure, the rate of heat transfer from the ambient atmosphere is effective in controlling the temperature of a specimen mounted on the warmer end of the heat transfer element thereby maintaining the specimen at a specific low constant temperature which is determined by the measured pressure of the vacuum chamber. (AEC)

44033 SUPERCONDUCTING PANCAKE COIL. Todoriki, Itaru; Koyama Ken-ichi. Denki Shikensho Iho, 32: 389-407 (June 1968). (In Japanese).

Some principal results of an experiment are reported on a superconducting pancake coil whose wire is SG-500 of AVCO Co. Ltd. The experiment is carried out as a preliminary one for a scheduled saddle-type superconducting magnet for a MHD generator. (1) The maximum flux density at the center of the pancake coil is 2.7 wb/m^2 and the corresponding critical current is about 820 A. These values satisfy the guaranteed characteristics of the wire. The magnetic field produced is not high enough for the coil to resume the superconductive state even when the current is reduced after the transition to the normal state occurs. However, it is found that the normal regions propagate gradually. (2) In cooling, only 3.8 liters of liquid helium is used to cool the 18-kG coil from 84 to 4.2°K. (3) Measurements of the parts of normal transitions, of the temperature inside the coil, and of the characteristics of the power leads were successfully conducted. (4) Two methods of power supply control, a current sweep and a voltage one, are compared in dissipative energy and power in the coil, and relations between the corresponding temperature rises in the normal regions and the dissipative energies are clarified. (NSA of Japan)

44034 RELATION BETWEEN SUPERCONDUCTIVITY AND LATTICE INSTABILITY IN THE β–W COMPOUNDS. Labbe, J. (Faculte des Sciences, Orsay, France). Phys. Rev., 172: 451-5 (Aug. 10, 1968).

The temperature T_0, at which the shear modulus $\frac{1}{2}(C_{11}-C_{12})$ vanishes in the cubic phase and in the normal state of some high superconducting β-W compounds, is calculated as a function of the small number Q of electrons (or holes) in the nearly empty (or nearly full) d subband. The variation of T_c with Q was calculated in a previous paper. It is shown that T_0 is much more sensitive than T_c to the value of Q, and thus to the exact chemical composition of the A_3B phase. Moreover, it is shown that when Q falls in some range of its value, a linear extrapolation at low temperatures cannot be used to obtain the value of T_0. [In other words, the temperature T_0' at which the extrapolated value of $\frac{1}{2}(C_{11}-C_{12})$ goes to zero may be somewhat different from the temperature T_0 at which $\frac{1}{2}(C_{11}-C_{12})$ is actually zero.] The failure of some samples to undergo the martensitic phase transition, when the extrapolated value of $\frac{1}{2}(C_{11}-C_{12})$ seems to go to zero in the normal state, may be explained in this way. Finally, it is found that at room temperature $\frac{1}{2}(C_{11}-C_{12})$ is minimum for some small value of Q. (auth)

44035 ON THE CAUSES OF MAGNETIC HYSTERESIS IN Nb–Sn SUPERCONDUCTING ALLOYS. Potapov, N. N. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Zh. Eksp. Teor. Fiz., 55: 14-24(July 1968). (In Russian).

A correlation is found between the characteristics of magnetic hysteresis and the structural peculiarities of Nb–Sn alloys. The structure defects that retard the magnetic flux in the Nb_3Sn compound are determined. Problems relating to capture of the flux and its escape from the sample are discussed. (auth)

44036 MOBILITY OF POSITIVE IONS IN ^3He–^4He SOLUTIONS. Kovdrya, Yu. Z.; Esel'son, B. N. (Physical-Technical Inst. of Low Temperatures, Kharkov). Zh. Eksp. Teor. Fiz., 55: 86-92 (July 1968). (In Russian).

The mobility of positive ions in ^3He–^4He solutions containing up to 29.0% of ^3He is measured by the time-of-flight technique at temperatures between 1.4 and 2.15°K and in fields up to 300 V/cm. It is shown that with increase of the concentration of ^3He the ion mobility in superfluid helium decreases. The decrease is most significant in the low-temperature region. The ion mobility related to scattering on impurities is determined on basis of the experimental data. The results are compared with existing theoretical concepts. (auth)

44037 LOW-TEMPERATURE HEAT CAPACITIES OF SUPERCONDUCTING MOLYBDENUM CARBIDES. Toth, L. E.; Zbasnik, J. (Univ. of Minnesota, Minneapolis). Acta Met., 16: 1177-82 (Sept. 1968).

Low-temperature heat capacities from 1.5 to 20°K have been measured for several molybdenum carbides with closely related crystal structures. These carbides are found to have very similar thermodynamic and superconducting properties. This similarity, as well as their unusually high T_c's, can be explained by their related crystal structures. An experimental evaluation of the applicability of the GLAG theory to these carbides shows that the upper critical field, H_{c2}, is limited by the Ginzburg–Landau κ_1 parameter, in which the coherence length is limited only by the electron mean free path. (auth)

44038 LOW-TEMPERATURE HEAT CAPACITIES OF SUPERCONDUCTING NIOBIUM AND TANTALUM CARBIDES. Toth, L. E. (Univ. of Minnesota, Minneapolis); Ishikawa, M.; Chang, Y. A. Acta Met., 16: 1183-7(Sept. 1968).

Low-temperature heat capacities have been measured from 1.5 to 18°K in the Nb–C and Ta–C binary systems to determine the effects of carbon concentration and crystal structure on the coefficient of electronic specific heat, Debye temperature, and the superconducting T_c. Comparison of the present results with other measurements on carbides and nitrides reveals very simple regularities in the variation of γ and θ_D values with composition and crystal structure. The rapid decrease in T_c with decreasing carbon concentration in the monocarbides results from a decrease in both the electron–phonon interaction parameter and the unrenormalized density of electron states. (auth)

44039 NONLINEAR CONCENTRATION DEPENDENCE OF SOUND VELOCITY IN ^3He–^4He SOLUTIONS. Abraham, B. M.; Eckstein, Y.; Ketterson, J. B. (Argonne National Lab., Ill.). Phys. Rev. Lett., 21: 422-4(Aug. 12, 1968).

Measurements are presented of the change in the velocity of sound in liquid ^{4}He on the addition of small quantities of ^{3}He for three compositions and three frequencies. It is shown that the change is not strictly linear in ^{3}He concentration and that the nonlinearity may be explained to a large extent if corrections to the ^{3}He effective mass, which arise from the many-body interactions, are included. (auth)

44040 LOW-TEMPERATURE ^{3}He MELTING CURVE. Scribner, R. A.; Panczyk, M. F.; Adams, E. D. (Univ. of Florida, Gainesville). Phys. Rev. Lett., 21: 427-9(Aug. 12, 1968).

The ^{3}He melting pressure to 17 mdeg K and the change in molar volume on melting to 30 mdeg K have been measured. These, along with the slope of the melting curve, are presented and compared with other results. (auth)

44041 ACCUMULATION OF CONTINUOUS INTENSE CURRENTS WITH A FLUX PUMP AND SUPERCONDUCTOR TRANSFORMER. Minet, Roger (Centre National d'Etudes des Telecommunications, Lannion, France). Compt. Rend., Ser. A and B, 266: 1561-4(June 24, 1968). (In French).

Owing to the principle of superconducting flux pumps, one can supply the primary of a transformer with continuous current. This permits the production of very intense currents from weak currents, introduced according to convenient cycles. Critical currents greater than a kiloampere could be attained and measured in niobium–zirconium samples. (tr-auth)

44042 SUPERCONDUCTIVITY AND QUASI ONE-DIMENSIONAL (THREAD-LIKE) STRUCTURES. Dzyaloshinskii, I. E.; Kats, E. I. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz., 55: 338-48(July 1968). (In Russian).

A model of a metal is considered which is one-dimensional with respect to all electron properties excluding oscillations of the electron density. As a consequence all previous objections against the possible existence of superconductivity of a peculiar one-dimensional type become invalid. With respect to magnetic properties our metal is a superconductor of the second kind with a critical field $H_{c2} \sim T_c/\mu$ (T_c is the transition temperature and μ the Bohr magneton) which considerably exceeds the thermodynamic field H_c. (Even at low transition temperatures of the order of 5 to 10°K the field H_{c2} will be of the order of hundreds of thousands Oe). (auth)

44043 APPEARANCE OF LOCAL BOUND STATES IN A SUPERCONDUCTOR WITH A MAGNETIC IMPURITY. Abrikosov, A. A. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz., 55: 380-4(July 1968). (In Russian).

It is shown that if the impurity spin S = 1 and the impurity concentration is sufficiently small, the condition for appearance of bound states is $T_K > T_{c0}$, where T_K is the Kondo temperature at which the bound states appear and T_K is the Knodo temperature at transition critical temperature of the pure metal. It is also demonstrated that under these conditions the magnetic impurity also diminishes transition temperature. (auth)

44044 APPARATUS FOR THE DETERMINATION OF MAGNETOTHERMODYNAMIC PROPERTIES TO HIGH FIELDS AT LOW TEMPERATURES UTILIZING A SUPERCONDUCTING MAGNET. Butera, R. A.; Kissell, F. N.; Stein, R. L. (Univ. of Pittsburgh). Rev. Sci. Instrum., 39: 1138-44(Aug. 1968).

An apparatus for the determination of magnetothermodynamic properties to high precision and low temperatures utilizing the field produced by a superconducting solenoid is described. The use of effluent heat exchangers and high efficiency wiring thermal anchors to minimize the consumption of liquid helium coolant during operation is discussed. Measurements of the magnetization and differential susceptibility as a function of field or temperature, as well as the heat capacity at constant field, may be determined without removal of the sample from the apparatus. Measurements on single crystals in various axial directions as well as on polycrystalline samples may be obtained using this apparatus. A discussion of the precision and accuracy of the measurements with this apparatus is presented. (auth)

44045 JOSEPHSON EFFECT IN SUPERCONDUCTORS SEPARATED BY A NORMAL METAL. Aslamazov, L. G.; Larkin, A. I.; Ovchinnikov, Yu. N. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz., 55: 323-35(July 1968). (In Russian).

The penetration of electron pairs into a normal metal results in the appearance of a superconducting current passing through the layer of a normal metal adjacent to the superconductors. The amplitude and frequency of the current as functions of applied voltage are determined. The electrodynamic properties of such a system are studied. (auth)

44046 APPLICATION OF THE RELATIVISTIC THEORY OF IRREVERSIBLE PHENOMENA TO THE PHENOMENOLOGY OF SUPERCONDUCTIVITY. Rothen, F. (Philipps-Univ., Marburg, Ger.). Helv. Phys. Acta, 41: 591-606(Aug. 15, 1968). (In French).

The dynamics of a superfluid system is described with the help of the relativistic theory of irreversible processes; one finds that it is the general form of enthalpy in a continuous system that allows the decomposition of the movement into a superfluid movement and a "normal" movement. The only specific assumptions are related to the superfluid, which is supposed to transport no entropy and to have an irrotational movement. In the case of a type-I superconductor moving with a uniform rotation speed $\vec{\omega}$, it is stated that the ratio of the so-created field to ω diverges from the elementary value $2\, m_{\text{electron}}/e_{\text{electron}}$; this is a measurable relativistic effect, following Josephson's suggestion. A result of Luttinger concerning the form of the thermal conductivity of a superconductor is generalized. (auth)

44047 FLUX JUMPS IN SUPERCONDUCTING Nb–50 PERCENT Ti RODS. Chikaba, J.; Irie, F.; Yamafuji, K. (Kyushu Univ., Fukuoka). Phys. Lett., 27A: 407-8(Aug. 26, 1968).

An applied magnetic field H_{fj}, at which the first flux jump in the initial magnetization occurs, was observed as the functions of sweeping rate dH/dt, bath temperature T_{He}, and sample size. A minimum was found in the H_{fj} versus dH/dt curve. (auth)

44048 THE PEAK EFFECT AND THE CLUSTERING OF DISSOLVED OXYGEN IN SUPERCONDUCTING Nb. Jones, K. A.; Rose, R. M. (Massachusetts Inst. of Tech., Cambridge). Phys. Lett., 27A: 412-13(Aug. 26, 1968).

One cause of the J_c peak effect in superconducting Nb may be the presence of clusters of dissolved oxygen. The peak effect in other cases may be attributed to other types of microstructural heterogenetities of the same size. (auth)

44049 ON THE OCCURRENCE OF THE PEAK EFFECT IN TYPE-II SUPERCONDUCTORS. Chang, C. C.; McKinnon, J. B. (Univ. of Manchester, Eng.). Phys. Lett., 27A: 414-15(Aug. 26, 1968).

Type-II superconductors showing the "peak effect" may have complicated voltage–current characteristics, and the appearance or not of a peak can depend on the choice of voltage used as a criterion for the appearance of resistance. (auth)

44050 PHASE-DEPENDENT SUPERCONDUCTIVE CURRENT DENSITY IN A SUPERCONDUCTOR /NORMAL METAL/ SUPERCONDUCTOR JUNCTION AT $T = T_{CN}$. Yeh, R. H. T.; Mechetti, H. (Univ. of Virginia, Charlottesville). Phys. Status Solidi, 28: 683-6(Aug. 1, 1968).

A general equation for the phase-dependent supercurrent density across the weak link is obtained, from which it is found that J_{max} at $T = T_{CN}$ decreases very slowly with d_N when compared with J_{max} at T near T_{CS}. (auth)

44051 SOUND DISPERSION IN SUPERCONDUCTING SEMICONDUCTORS. Vas'kin, V. V.; Demikhovskii, V. Ya. (Gorky State Univ., USSR). Sov. Phys.-Solid State (Engl. Transl.), 10: 330-3(Aug. 1968).

Translated from Fiz. Tverd. Tela, 10: 419-24(Feb. 1968).

The acoustic phonon dispersion law is studied in a semiconductor in the superconducting state. Under conditions where the sound velocity is close to the Fermi velocity, i.e., the conditions $kv_0 \sim \Delta$ and $\omega \sim 2\Delta$ are fulfilled simultaneously, the dispersion law is substantially nonlinear. In superconductors, where c/v is always small, no characteristic features were observed in the dispersion law for sound in the region $kv_0 \sim \Delta$, nor when $\omega \sim 2\Delta$. (auth)

44052 EFFECT OF CONCENTRATION NONUNIFORMITY ON THE PROPERTIES OF SUPERCONDUCTORS WITH PARAMAGNETIC IMPURITIES. Kulik, I. O.; Itskovich, O. Yu. (Physical-Technical Inst. of Low Temperatures, Kharkov). Zh. Eksp. Teor. Fiz., 55: 193-207(July 1968). (In Russian).

The problem of calculating the critical temperature of a superconducting alloy with a nonuniform distribution of paramagnetic impurities c(r) is investigated by means of a generalization of the Abrikosov–Gorkov theory (the characteristic inhomogeneity dimension δ_0 and coherence length ξ_0 are assumed to be large compared to the mean distance between the impurities). By analogy with the problem of determining the spectrum of disordered systems, the concepts of a "renormalized" critical temperature T_c (this quantity is the same as that introduced in the Abrikosov–Gorkov theory) and also of a "true" critical temperature T_c' ($T_c' > T_c$) due to fluxtuations are introduced. For $T > T_c$ the superconductivity pattern is that of "islets" of the superconducting phase separated by normal regions. The generalized Ginzburg–Landau equation is employed for studying localized states at $T > T_c$ (superconducting "nuclei"). It is shown that for $c(r) \neq$ const and small concentrations the equation contains a "potential energy" term which is a linear function of the impurity concentration. (auth)

44053 NONLINEAR EFFECT IN THE SHEAR-WAVE ATTENUATION NEAR T_c IN SUPERCONDUCTORS. Fossheim, K. (Univ. of Oslo). Phys. Rev., 173: 526-30(Sept. 10, 1968).

A semiquantitative model is proposed to explain the observed amplitude dependence of shear-wave attenuation near the superconducting transition temperature of indium. It is shown that, when an ultrasonic wave of high amplitude is imposed on the lattice of a superconductor, the wave has to be treated as a strong perturbation near T_c. This implies a strong spatial dependence in the superconducting order parameter. A calculation of the resulting attenuation is made on the basis of a simplified model, equivalent to replacing the equilibrium order parameter by a periodic step function. A strong amplitude dependence in the attenuation is obtained, and it is shown that the effect may change the temperature dependence of the entire transition curve for the electromagnetic attenuation. (auth)

44054 SURFACE IMPEDANCE OF TYPE-I SUPERCONDUCTORS: CALCULATION OF THE EFFECT OF A STATIC MAGNETIC FIELD. Garfunkel, M. P. (Cambridge Univ., Eng. Univ. of Pittsburgh). Phys. Rev., 173: 516-25(Sept. 10, 1968).

The microwave surface impedance of pure type-I superconductors in a static magnetic field is calculated at frequencies in the range $10^{-5} \leq \hbar\omega/\Delta \leq 3$. In the theory developed, the effect of the static field is to change the quasiparticle energies by an amount $p \cdot v$, where p is the Fermi momentum and v is the drift velocity associated with the Meissner current. The results are in general agreement with the high-frequency ($\hbar\omega/\Delta \sim 2$) experiments, and show the "anomalous" decrease in both surface resistance and reactance that occurs in the experiments at lower frequencies ($0.01 \lesssim \hbar\omega/\Delta \lesssim 0.2$). Finally, the results lead to a simple quadratic field dependence of the surface reactance in the low-frequency limit ($\hbar\omega/\Delta < 0.01$), where the form of the calculation is similar to both the experimental results and the predictions of the Ginzburg–Landau theory. (auth)

44055 ULTRASONIC ATTENUATION IN SUPERCONDUCTING MERCURY AND MERCURY–CADMIUM SINGLE CRYSTALS. Newcomb, C. P.; Shaw, R. W. (Rensselaer Polytechnic Inst., Troy, N. Y.). Phys. Rev., 173: 509-15(Sept. 10, 1968).

The results of low-temperature ultrasonic-attenuation studies in mercury single crystals, polycrystals, and mercury single crystals with varying concentrations of cadmium impurity are presented. The frequency ranged from 10 to 130 MHz and the doping concentration from 0.01 to 0.10% by weight. The major emphasis is a systematic study of the deviations of α_s/α_n for longitudinal ultrasound from that predicted by the BCS theory. These deviations are a drop in α_s/α_n with decreasing temperature near T_c, which is greater than that predicted by BCS. The rapidity of the drop increased with increasing frequency in all pure samples, but was frequency-independent and decreased with doping concentration in the doped samples. The deviations observed cannot be explained adequately by dislocation attenuation or by multiple anisotropic energy gaps. (auth)

44056 EFFECT OF TEMPERATURE AND OF SUBSTITUTIONAL Mo ON THE MAGNETIC BEHAVIOR OF SUPERCONDUCTING Nb. French, R. A.; Lowell, J. (Oxford Univ.). Phys. Rev., 173: 504-9(Sept. 10, 1968).

The temperature and mean-free-path dependence of the magnetic properties of highly reversible samples of Nb and some of its alloys with Mo are compared with recent generalizations of the Ginzburg–Landau–Abrikosov–Gor'kov theory. The temperature dependence of κ_1 and κ_2 in pure Nb is much more rapid than the theoretical predictions, as in the measurements of Finnemore et al. The disparity between theory and experiment decreases with increasing Mo content. The temperature dependence of the lower critical field of pure Nb is in violent disagreement with theory, while at least qualitative agreement is found in the case of the alloy samples. (auth)

44057 MAGNETIC TRANSITIONS OF SUPERCONDUCTING THIN FILMS AND FOILS. II. TIN. Miller, R. E.; Cody, G. D. (RCA Labs., Princeton, N. J.). Phys. Rev., 173: 494-503 (Sept. 10, 1968).

The perpendicular and parallel magnetic critical fields of pure tin films and foils have been measured as a function of temperature (1.3°K to T_c) and specimen thickness (500 Å to 220 kÅ). The critical field $H_\perp$ for specimens of thickness less than a critical thickness d_c is in good agreement with Tinkham's vortex model for thin films if one assumes a thickness dependence for the penetration depth. For thicker films and foils the observed thickness dependence of $H_\perp$ is in good agreement with a theory based on the effect of positive surface energy on the free energy of the intermediate state. The measured parallel critical field $H_{||}$ is in excellent agreement with Ginzburg–Landau theory for type-I superconductors in both the thin- and thick-film limits. For films thinner than a critical thickness d_c', the transition is of second order and the relationship between $H_\perp$, $H_{||}$, and the film thickness is in excellent agreement with the "universal curve" of Saint James and de Gennes for second-order transitions. For films thicker than d_c', the transitions are of first order, and the critical fields approach the Ginzburg–Landau limit valid for $d \gg \lambda$. A comparison of the observed critical thicknesses d_c and d_c' with theoretical calculations has been made. From the data, bulk values for $\kappa(t)$, $\lambda(t)$, $\lambda_L(0)$, ξ_0, and Δ have been computed, and the thickness dependence of $\kappa(t)$ and $\lambda(t)$ has been estimated. (auth)

44058 MAGNETIC TRANSITIONS OF SUPERCONDUCTING THIN FILMS AND FOILS. I. LEAD. Cody, G. D.; Miller, R. E. (RCA Labs., Princeton, N. J.). Phys. Rev., 173: 481-93 (Sept. 10, 1968).

The perpendicular and parallel magnetic transitions for pure Pb films and foils have been determined from transverse magnetization and ac susceptibility measurements as a function of thickness (400 Å to 35 μ) and temperature (1.4 to 4.2°K). The perpendicular critical field ($H_\perp$) for thicknesses less than a critical thickness, $d_c \approx 15$ kÅ, is in good agreement with the theory of Tinkham if it is assumed that the penetration depth is thickness-dependent. The data for thicknesses above d_c follow a thickness dependence predicted from the effect of a positive surface energy on the free energy of the intermediate state. At d_c there is a minimum in $H_\perp$. The parallel critical field ($H_{||}$) up to d_c is in good agreement with the theory of Saint James and de Gennes for a second-order transition. Above d_c, $H_{||}$ agrees with the bulk value of H_{c3} for lead. In the vicinity of d_c, the magnetization curve starts to exhibit a reversible tail, which persists to larger thicknesses and whose slope is in reasonable agreement with theory. From the data, the bulk values of $\kappa(T)$, $\lambda(T)$, $\lambda_L(0)$, and ξ_0, as well as the thickness dependence of these quantities, have been computed. (auth)

44059 HYSTERESIS IN SUPERCONDUCTORS. III. EFFECT OF SURFACE ENERGIES ON THE SHIELDING AND FIELD-RETAINING PROPERTIES OF HOLLOW CYLINDERS OF TYPE-I SUPERCONDUCTORS. Schweitzer, Donald G. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 173: 461-72(Sept. 10, 1968). (BNL–12069).

The diamagnetic and field-retaining properties of thin-walled type-I hollow cylinders can be changed by more than an order of magnitude through the introduction of surface strains. High-purity hollow cylinders of Pb and Sn in which the surface strains are minimal shield external fields of only a few percent of H_c and do not retain appreciable fields in the void when an external field exceeding H_c is removed isothermally. The shielding and field-retaining properties are influenced by localized phenomena. The introduction of local surface strains increases the local shielding properties during the application of an external field and leads to the retention of large axial field gradients in the void after the applied field is removed. Fields of both senses can be retained in the void simultaneously when cycles are performed involving both senses of the applied field. Some experiments are summarized showing spontaneous field enhancement when type-I superconductors are cooled in applied fields. A number of unexpected reversibility relations are associated with these phenomena. The effects can be accounted for by including surface and interface energy terms in the thermodynamic state function of the superconductor. An example of how hysteresis arises from equilibrium changes is described. (auth)

44060 USE OF PHYSICAL METHODS FOR REVEALING INHOMOGENEOUS COMPOSITION AND STRUCTURE IN Nb–Zr ALLOYS. Baranov, I. A.; Bychkov, Yu. F.; Zuev, M. T.; Sokolov, N. A.; Shmulevich, R. S. Defektoskopiya, No. 3, 35-40(1968). (In Russian).

The influence of inhomogeneous chemical composition in superconducting Nb–Zr alloys on the magnitude of degradation of critical current density was studied. It is revealed that the inhomogeneous composition and nonuniform structure are the causes of high degradation. Descriptions are given of the method for controlling composition homogeneity of the single-phase alloys by measuring the lattice parameter and structural uniformity of two-phase alloys by controlling thermoelectrical forces and ρ in the wire. Theoretical and experimental data were correlated. (R.V.J.)

44061 INVESTIGATION OF HELIUM AT PRESSURES ABOVE THE CRITICAL PRESSURE FOR COOLING SUPERCONDUCTING SYSTEM IN SPACE FLIGHT CONDITIONS. Anashkin, O. P.; Belitskii, B. M.; Brodskii, V. B.; Kurnosova, L. V.; Mikhailov, N. N.; Razorenov, L. A.; Sidyakina, T. M.; Fradkin, M. I. (Physical Inst., Moscow). Prib. Tekh. Eksp., No. 3, 218-21(May-June 1968). (In Russian).

The experimental results on the study of the use of superconducting systems on board space ships are reported. In order to guarantee the low temperature in the cryostat under conditions of weightlessness, helium at pressures above the critical pressure (2.4 atm, original temperature 5.2°K) was used. The cryostat was calculated for operation under conditions of significant overload and vibration. In flight, the temperature, pressure, and magnetic field intensity in the solenoid are controlled at six points in the helium volume. The results obtained verify the possibility of using helium as a coolant for superconducting systems in conditions of weightlessness. (tr-auth)

44062 EFFECT OF DEVIATIONS FROM STOICHIOMETRY ON CERTAIN PROPERTIES OF THE PHASE Nb_3Sn. Medvedev, S. A.; Kiseleva, K. V.; Lykhin, V. A. (Lebedev Inst. of Physics, Moscow). Fiz. Metal. Metalloved., 24: 1050-5(1967). (In Russian).

The investigation dealt with determining the boundaries of the region of existence of the phase $Nb_{3+\delta}$ Sn, where δ is a small quantity denoting deviation from the stoichiometric composition of the phase, as well as with the effect of such deviations on the superconducting transition temperature and on the lattice parameters of the phase. To this end, specimens of the stoichiometric compound Nb_3Sn synthesized by the method of the self-dissolving crucible (heating at 1200 to 1600°C of a thick-walled crucible of pure Nb containing pure Sn) were subjected to heat treatment in order to create a varying degree of deviation from a rigorously stoichiometric composition. The heat treatment consisted in the vacuum heating of a weighed portion of crystals of the compound to 1300°C, which resulted in the evaporation of some amount of Sn from the Nb_3Sn lattice. The loss of Sn could be regulated by varying the time of this heat treatment. The specimens thus attained were chemically analyzed and their transition temperature T_{cr}, lattice parameters, and degree of occupancy of the Nb and Sn sublattice nodes were determined by induction and x-ray diffraction methods. Findings: for the stoichiometric compound Nb_3SN the Nb content is 75 ± 0.05 at. %; the lattice parameter, a = 5.300 ± 0.0017 Å; and T_{cr} = 17.9 ± 0.04°K, whereas for the stoichiometric compounds with 75 to 77 at. % Nb the parameter a is constant and equal to 5.300 Å and for the compounds with 77 to 78.16 at. % Nb the value of a decreases to 5.2885 Å. Phase analysis shows that in the compound with ~78.16 at. % there is present, in addition to the basic phase, a second phase—solid α solution of Nb with Sn (cubic lattice with the parameter 3.296 Å). Thus the region of existence of the A-15 phase (Nb_3Sn) ranges from 75 to 78.16 at.% Nb. This region of existence may be subdivided into two sectors in which the properties differ: (1) within the range of from 75 to 77.5 at. % Nb the concentration of electrons in Nb nodes increases and T_{cr} rises to 18.2°K, while the lattice parameter a remains constant; and (2) within the range of from 77.5 to 78.16 at. % Nb, the concentration of electrons in Nb nodes begins to decrease (the disintegration of Nb chains commences), T_{cr} drops below 17.9°K and decreases sharply. At the boundary of existence of the phase A-15 (78.16 at. % Nb) these changes in properties cease. Thus these findings are in good agreement with the theory of Courtney et al. (J. Trans. Met. Soc., AIME, 233: 212 (1965)), who relate the high T_{cr} of Nb_3Sn to the existence of regular orthogonal chains of Nb atoms; disintegration of these chains must cause a fall in T_{cr}, and vice versa. The causes of disintegration of the chains may include the formation of vacancies in the chains (migration of Nb atoms from their sites) or lattice disorders (presence of Nb atoms in Sn nodes, and vice versa). (ATD)

44063 PRELIMINARY OBSERVATIONS ON THE MICROSTRUCTURE OF THIN-WIRE Nb-44 PERCENT Ti SUPERCONDUCTOR. Gidley, J. A. F.; Richards, P. N.; Barber, A. C. (Imperial Metal Industries Ltd., Birmingham, Eng.). Nature (London), 219: 479-80(Aug. 3, 1968).

The critical current density (J_c) of a hard superconductor is controlled to some extent by the metallurgical structure of the material. Many commercially available superconducting materials contain fine filaments of Nb–Ti alloy, and a detailed examination of the structure of these filaments is of considerable importance. It is necessary to examine the structure in the transverse plane in order to relate J_c to defect structure, and techniques have been developed, involving only electropolishing, that allow thin foils to be prepared from both transverse and longitudinal sections of fine wires. Transmission electron micrographs are shown of such sections of "Niomax-S" wires in the commercial cold worked and heat treated conditions. This material has a critical current of 10^5 A cm^{-2} in a transverse 50-kG magnetic field. A fibrous structure is seen, with no sign of anisotropy in the transverse section. Cell diameters range from 250 to 1250 Å (average ~700 Å). The dislocation density within the cells is very low. (UK)

Plasma and Thermonuclear Physics

44064 (NP-17580) BIBLIOGRAPHY ON THE HIGH-TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND PLASMAS. No. 27. Brewer, L. (comp.) (California Univ., Berkeley. International Union of Pure and Applied Chemistry. Commission on High Temperatures and Refractories). June 30, 1968. 18p. NBS, Washington, D. C. Free.

Ninety-five articles dealing with the reactions between gases and condensed phases are listed. A listing of 74 articles on high-temperature spectroscopy is also included. (M.O.W.)

Confinement and Heating of Plasma

Refer also to abstract 43186.

44065 (INR-912) RESEARCH ON PRODUCTION AND CONTAINMENT OF PLASMA IN A SPHERICAL MULTIPOLE MAGNETIC FIELD. I. THE CONCEPT AND EXPERIMENTAL PROGRAM. Sadowski, Marek (Institute of Nuclear Research, Warsaw (Poland)). 1968. 37p. (In Polish). Dep.

Conditions to be fulfilled for effective hot plasma containment are presented. Comparison of different magnetic traps is given, and the concept of plasma confinement involving a spherical multipole magnetic field is discussed. The "Kaktus" research project is described, and comparison of the geometry or different spherical multipoles is given. Results of investigations of a selected variant of the containment field are also presented. (auth)

44066 (INR-914) RESEARCH ON PRODUCTION AND CONTAINMENT OF PLASMA IN A SPHERICAL MULTIPOLE MAGNETIC FIELD. III. RESULTS OF EXPERIMENTAL STUDIES. Sadowski, Marek (Institute of Nuclear Research, Warsaw (Poland)). 1968. 46p. (In Polish). Dep.

The results are presented of experimental research on the production and containment of hot plasma in a spherical multipole magnetic field. Investigations of the synchronous operation of 6 fast gas valves and 6 plasma injectors are described. The lifetime of the plasma is assessed on the basis of integral visible radiation. For comparison with the above lifetime, measurements performed in the conventional cusped geometry, and in a hybrid SM trap with an additional mirror field are described. Results of probe measurements of the plasma lifetime in the traps investigated are given. The investigations referred to prove that the plasma lifetime in the SM-type trap (under conditions of the experiment 85 μsec) is approximately 3 times that in the cusp configuration, with the other experimental conditions identical. (auth)

44067 (JUL-513-PP) BERECHNUNG EINES GEPULSTEN ZWEIDIMENSIONALEN MAGNETFELDES BEI VORGEGEBENER SPULENGEOMETRIE. (Calculation of a Pulsed Two-Dimensional Magnetic Field by an Assumed Coil Geometry). Janicke, L.; Krueger, J. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Plasmaphysik). Jan. 1968. 62p. (In German). Dep.

A method was developed for the calculation of the magnetic field of pulsed rotational symmetrical coils, in which multiparticle coils can also be considered. The stationary field of a coil from infinitely conducting material was used as model. For solution of the boundary problem (the normal component of the field should disappear at the surface) the field of the magnetic surface charge was taken as an auxiliary so that the charge density is given as a solution of a second-order singular Fredholm integral equation. This integral equation is solved approximately by discretization and the requirement of the stepwise flux constants. The convergence and accuracy of the method, i.e., control possibilities for the numerical error, are discussed. The results of the numerical calculation for a long gap cylindrical coil and for a cusp coil are given as examples. (tr-auth)

44068 (LA-DC-9328) MONTE CARLO AND COMPUTER PLASMA SIMULATION STUDIES OF THE INHIBITION OF END LOSS FROM A θ-PINCH BY NONADIABATIC ROUGH MAGNETIC WALLS. Tuck, James L. (Los Alamos Scientific Lab., N. Mex.). [1967]. Contract W-7405-eng-36. 12p. (CONF-680805-11). Dep. CFSTI.

From 3rd International Conference on Controlled and Plasma Physics, Novosibirsk, USSR.

A combination of uniform magnetic field, with its manifest advantages for stable plasma confinement in the direction transverse to the field, with some effective check of the free flow of plasma in the direction along the field, could be of appreciable help in the achievement of net power from a thermonuclear reaction. Monte Carlo studies of particles escaping from a $\beta = 1$ θ pinch, having a sharp plasma-field boundary equipped with multiple small perturbations have indicated that cumulative nonadiabatic effects can be promoted. The plasma model studied was probably too simple to be altogether valid for a real plasma; plasma loss reductions which resulted were surprisingly large. Static perturbations which would be simple to apply, reached a factor of ten reduction of loss, while moving perturbations reached a factor of 100. The latter would be complicated to apply but, imaginably, could be used additionally to heat plasma and force it up to the density gradient. A far more sophisticated (but still approximate) study is now beginning to yield results. Using a previously developed computer simulated θ-pinch plasma model of R. L. Morse with appropriately modified magnetic field, 13,000 particles are followed at high β, the magnetic field being computed self-consistently. Electrons are assumed to maintain space charge neutrality at all points. The systems studied so far, with their losses at two-thirds characteristic time are: (1) open-ended θ-pinch (smooth walls) (4000), (2) open-ended θ-pinch (smooth walls) plus mirror (3400), (3) open-ended θ-pinch (rough walls) (stationary) (2800), and (4) open-ended θ-pinch (rough walls) (moving) (2400). 1 characteristic time = 2 × pinch length/mean thermal speed ≈ 2.8 μsec. (Scylla IV) IV) = 100 time steps = 3 hrs computing time on CDC 6600. The loss rates per time step at t = 67 are 59, 22, 24, 24 and 28, respectively. Adequate description of the plasma distribution in the radial direction required 20 steps: the longitudinal steps numbered 100. Although this corresponds to a shorter system than had been found necessary for a 10-fold loss reduction in the previous calculation, it is needed to keep the computation cycle time down to feasible values. Consequently, the loss rate reductions to be expected are not large. The table shows the number of particles lost after 67 time steps (~2.3 characteristic time). The results are in the expected order. The computed loss rate for (1) at early times is in excellent agreement with theory for a rigid pipe with reflecting walls and interestingly thereafter falls below theory, presumably on account of the development of self-mirrors. Case (3), if its performance continues, should give the required 10-fold reduction of loss rate, for a 6-fold length extension or a total length of 160 radii. This would be quite practical. Motion pictures of the printouts (shown) exhibit waves and bunching phenomena which may repay further study. Mathematical plasma physics is notoriously difficult; the problems it has attacked in many cases have had to be taken far from reality in order to yield solutions. Few expect a mathematical description of all the behavior of a real confined plasma with its wave interactions, plasma boundary resonances, wall resonances, radiative interactions etc., to become available in the near future. The art of computer plasma simulation is still in its infancy. In this paper, it is applied in a simplified way to a complicated system which would probably not easily be treated by mathematical analysis. It would be idle to pretend that the predictions made are exact—and they may turn out no closer to reality than those made by more familiar approximations. However, they are likely to improve, and the approximations are different. (auth)

44069 (MATT-620) LINEAR MULTIPOLE AND SPHERATOR EXPERIMENTS. Yoshikawa, S.; Barrault, M.; Harries, W.; Meade, D.; Palladino, R.; von Goeler, S. (Princeton Univ., N. J. Plasma Physics Lab.). July 1968. Contract AT(30-1)-1238. 27p. (CONF-680805-19). Dep. CFSTI.

From 3rd International Conference on Controlled and Plasma Physics, Novosibirsk, USSR.

In both the linear multipole device (LM-1) and the spherator (SP-1), plasma confinement times were found to be limited to ~10 times Bohm time in the rf-produced plasmas where density and temperature were such that isotropic pressure distribution was expected. In the linear multipole device, plasma loss is mainly across the magnetic field, while in the spherator, plasma loss is roughly equally divided among limiter loss, support loss, and poloidal field coil loss. With gun-injected plasmas in LM-1, the plasma loss to the end could be increased over that of the loss radially outwards, but the latter is still finite. If we make allowance for the end loss, the confinement times over the Bohm times could be increased up to ~50 times. Fluctuations between 1 kc and 1 Mc were observed only in the limited portion of the density profiles (or sometimes none throughout the density profiles), yet the density profiles normalized at the peak density do not change appreciably with time. Hence, one concludes that an additional mechanism(s) of the plasma transport other than fluctuations is present. The mechanism for this particle loss could lie in the equilibrium. In the case of LM-1, it was observed experimentally that the plasma pressure does not follow $p = p(\oint dl/B)$. A corresponding equilibrium solution was obtained theoretically. In the case of the spherator, within the experimental accuracy, $p = p(\psi)$, but it is still possible that convective cells, undetected, still exist. One possible hypothesis is that the existence of supports creates the perturbation which gives rise to cross-field convection. The fact that the confinement times depend on ion mass is highly suggestive of this hypothesis. The experiment to test this hypothesis awaits the levitated-ring experiment. (auth)

44070 (MATT-621) EXPERIMENTAL STUDIES OF ANOMALOUS RESISTIVITY AND THE ASSOCIATION OF FLUCTUATIONS AND COLLISION FREQUENCY WITH CONFINEMENT. Brown, I. G.; Dimock, D. L.; Mazzucato, E.; Rothman, M. A.; Sinclair, R. M.; Young, K. M. (Princeton Univ., N. J. Plasma Physics Lab.). July 1968. Contract AT(30-1)-1238. 17p. (CONF-680805-12). Dep. CFSTI.

From 3rd International Conference on Controlled and Plasma Physics, Novosibirsk, USSR.

Experiments were directed toward elucidation of the anomalous plasma loss in the C stellarator. The experiments all make use of ohmic heating to form the plasma, but one finds that the detailed properties observed depend markedly on the ratio of the current drift velocity to the particle thermal velocities. As u_e/v_i becomes greater than unity with ohmic heating, the plasmas become collisionless in the sense that $\lambda_e \gtrsim L$. Alternatively, the collisionless regime has been attained by Landau damping of ion cyclotron waves by the electrons with $u_e/v_i < 1$. (auth)

44071 (MATT-624) LOW-FREQUENCY PLASMA LOSS MECHANISMS IN MHD-STABILIZED TORUSES. Furth, H. P.; Rosenbluth, M. N. (Princeton Univ., N. J. Plasma Physics Lab.). July 1968. Contract AT(30-1)-1238. 30p. (CONF-680805-16). Dep. CFSTI.

From 3rd International Conference on Controlled and Plasma Physics, Novosibirsk, USSR.

Anomalous plasma losses can occur even in the absence of apparent fluctuations, through the mechanism of large single-particle excursions in spatially irregular quasistatic magnetic and electric fields. The conservation of the second adiabatic invariant J provides the basis for a general analysis of these low-frequency mechanisms. In sheared magnetic fields, the presence of a regular electrostatic potential $e\Phi_0 > kT\, r_0/R_0$, constant on magnetic surfaces, is sufficient to suppress single-particle excursions in both axisymmetric and stellarator geometry. The effect on particle excursions of irregular electrostatic potentials is investigated and in the limit of small gyroradii and strong shear is found to be comparable to the effect of nonsymmetric (stellarator) geometry. Magnetic trapping of particles lends itself to self-consistent irregular potentials (convective cells); while electrostatic trapping leads to a stable drift mode, and to the possibility of convective cells. Shearless magnetic wells (multipoles), are unstable against growth of MHD convective cells. For small plasma potentials, however, the instability goes to short wavelength where the MHD approximation breaks down. Small gyroradii and deep magnetic wells are found to be favorable to the suppression of particle convection. (auth)

44072 (MATT-625) EFFECT OF SHEAR AND CONNECTION LENGTH ON DRIFT WAVES AND PLASMA CONFINEMENT. Chen, F. F.; Mosher, D.; Rogers, K. C. (Princeton Univ., N. J. Plasma Physics Lab.). July 1968. Contract AT(30-1)-1238. 20p. (CONF-680805-13). Dep. CFSTI.

From 3rd International Conference on Controlled and Plasma Physics, Novosibirsk, USSR.

The effectiveness of shear and of short connection length on drift instabilities in a 0.22-eV thermally ionized, 3-meter-long potassium plasma was investigated. These experiments were carried out with T_i/T_e and ρ_i/R in a regime comparable to what would obtain in a fusion reactor. In the density range $n = 10^9$ to 10^{11} cm^{-3}, the transition from collisionless to collisional excitation of drift waves is covered; ion viscosity is important only at highest densities studied. By tailoring the radial electric field, it is possible to produce quiescence, turbulence, or single modes. Shear is applied by passing current through a 1-cm-diam. hard core along the axis. Both turbulent and coherent drift waves are stabilized by shear of order $\theta \sim 0.05$, in fair agreement with the theory of Krall and Rosenbluth. However, at large shear, small-amplitude coherent oscillations reappear unexpectedly. At zero shear, $D_\perp$ is 2 to 3 times the Bohm diffusion coefficient; at maximum shear, $D_\perp$ is decreased a factor of 5 to 30 to 2 to 3 times the classical value. At least half of $D_\perp$, however, is not connected with oscillations at all; it is due to the dc drifts in weak asymmetric electric fields produced by temperature variations at the end plate. The twisting of the equipotentials into spirals and thus symmetrization of the E fields has been observed in detail experimentally. A finite-Larmor-radius theory for the effect of shear in reducing the radial drift is found to be in agreement with the observed reduction in $D_\perp$. Short connection length is achieved by internal current loops providing a B_z opposing the main B_z, thus creating stagnation points lying on the axis. In the vicinity of each ring, the plasma is bent around the ring and is stabilized by both minimum-$\bar{B}$ and viscous damping. The rings are spaced 75 to 180 cm apart, and between rings the field is uniform. Thus, instabilities are restricted to those with short $\lambda_{||}$. It is found that the oscillation level is greatly reduced by current in the rings. (auth)

44073 (NP-17551) INVESTIGATION OF HEATING OF PLASMA BY FAST, LARGE-AMPLITUDE, MAGNETOSONIC

WAVE. Vasil'ev, M. P.; Grigor'eva, L. I.; Longinov, A. V.; Smerdov, B. I.; Chechkin, V. V. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). 1968. 18p. (In Russian). Dep.

Under study is the resonant excitation and absorption of fast magnetosonic waves in hydrogen plasma within a frequency range of $\omega_i \lesssim \omega \ll \sqrt{\omega_i\omega_e}$ (ω_i,ω_e are, respectively, the cyclotronic frequencies of the ions and electrons and ω is the frequency of the wave) with the plasma having a density of 10^{13} to 10^{14} cm^{-3}. The variable field in the plasma was generated by a coil consisting of several sections connected in pairs and in antiphase. The coil served as an inductance of the impact circuit with a reserved energy of up to 10 joules and a frequency of 7×10^6 cycles. During the resonant excitation by a fast magnetosonic wave, the plasma received up to 70% of the energy stored in the circuit. At this, the amplitude of the variable magnetic field in the plasma reached an amplitude of 500 oersteds. There took place a fast ($\lesssim 1$ μsec) heating of electrons to an average energy of ~200 eV and of the ions to ~20 eV. The velocity distribution was measured for the electrons and ions arriving from the plasma along a constant magnetic field at large and low amplitudes of the high-frequency field. The possible mechanisms responsible for the observed attenuation of the wave and the heating of the plasma are under discussion. (JPRS)

44074 (NP-17561) TOROIDAL EFFECT ON THE MAGNETIC SURFACE OF STELLARATOR. Preprint No. 114. Danilkin, I. S.; Karpenko, I. K. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). 1967. 35p. (In Russian). Dep.

Magnetic surfaces in a two-inlet stellarator were investigated, considering corrections for the system curvature K, and using methods previously developed by Mercier (Nucl. Fusion, 4: 213 (1964)) and others. Surfaces in the vicinity of the magnetic axis system, whose position depends on current distribution in the stellarator helical magnetic field, were determined by exact solutions for the magnetic field potential, previously developed by L. M. Kovrizhnykh (Zh. Tekh. Fiz., 33: 377(1963)). Data obtained described the system of magnetic surfaces in the preaxial area and the qualitative topological changes in the peripheral region (in the vicinity of the separatrix of the initial system with $K = 0$). (tr-auth)

44075 (NP-17565) THE PLASMA-ELECTRON CONFINEMENT REGION FOR ELECTRON-CYCLOTRON RESONANCE IN A MAGNETIC TRAP WITH PLUGS. Galaktionov, B. V.; D'yachenko, V. V.; Novik, K. M.; Piliya, A. D. (Akademiya Nauk SSSR, Leningrad. Fiziko-Tekhnicheskii Institut). 1968. 9p. (In Russian). Dep.

It has been shown theoretically that when plasma is heated by an ultrahigh-frequency field under conditions of electron-cyclotron heating in a trap with plugs, all of the electrons are reflected from the magnetic plugs in the same plane, in which the ultrahigh-frequency power is also absorbed. It was attempted to determine experimentally the region of reflection of the plasma, using two devices with open traps, with a plug similar to the configuration of the magnetic field; the ultrahigh-frequency power was conducted to the plasma by means of a waveguide. At the maximum of the magnetic field a single 4-μsec uhf pulse was sent into the plasma by the 20-kW, 9350-MHz generator. The concentration of the plasma was measured by means of a microwave interferometer. The results confirmed the authors' previous findings, indicating that there is a narrow region near the resonance value of the magnetic field, in which the charged particles are reflected. (TTT)

44076 (NP-17567) CYCLOTRON HEATING OF PLASMA IONS AND ELECTRONS BY HIGH-FREQUENCY FIELDS. Galaktionov, B. V.; Novik, K. M.; Podushnikov, K. A.; Poloskin, B. P. (Akademiya Nauk SSSR, Leningrad. Fiziko-Tekhnicheskii Institut). 1967. 11p. (In Russian). Dep.

An independent plasma electron heating in a magnetic trap by means of ultrahigh-frequency fields and ion heating by means of high-frequency fields near cyclotron resonances and their harmonics was achieved on a specially designed device. The device consisted of a glass discharge tube 5 cm in diameter with a quasi-stationary longitudinal magnetic mirror field with mirror ratio 1.85 and a distance of 100 cm between mirrors. Preliminary pumping was up to 10^{-6} mm Hg, the chamber pressure 4×10^{-4} to 2×10^{-3} mm Hg. An ultrahigh-frequency generator of 9100 MHz and 600 V, operating under quasi-stationary conditions with up to 1 sec pulse duration, was used in the experiment. Graphical data are given on the high-frequency probe signal, electron concentration, and integrated ion and electron temperature as functions of the magnetic field. The high temperature produced by the fields was achieved under conditions of limited collisions and increased generator power. (R.V.J.)

44077 (NP-17586) PARTICLE MOTION IN HELICAL FIELDS WITH EQUIPOTENTIAL COINCIDING MAGNETIC SURFACES. Preprint No. 51. Popryadukhin, A. P. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). 1968. 21p. (In Russian). Dep.

Electrical field effects on the motion of particles in a system of helical symmetry were studied. The data show that even small electric fields exert an effect which results in strong redistribution of particle velocities according to various types of motion. Detailed studies of particle motions in complex configurations of electric fields are reported. (R.V.J.)

44078 A SOLENOID ABLE TO CREATE A MAGNETIC FIELD UP TO 30 kOe IN A VOLUME OF 5 LITERS AT AN INPUT OF 500 kW. Kapitsa, P. L.; Filimonov, S. I. (Inst. of Physical Problems, Moscow). Usp. Fiz. Nauk, 95: 35-43(May 1968). (In Russian).

As part of the plasma research, a solenoid with special coils and cooling system was developed for the purpose to create a constant magnetic field. The iron yoke of the solenoid improved the homogeneity of the magnetic field within the solenoid, while decreasing the scattered external field. A 500-V, 500-W, dc generator was used for the current supply. Purified water was circulated through the cooling system made of copper and stainless steel. In order to protect the system against overvoltage during a sudden shutdown, the coil was directly connected to the generator, without an intermediate switch. The distribution of the magnetic field as a function of the current, and the axial field distribution were determined by a magnetometric method, based on the measurement of nuclear resonance in water. The design may be used for power levels exceeding several times the rating of 500 kW. (TTT)

44079 SPHERICAL MULTIPOLE AS A PLASMA MAGNETIC TRAP. Sadowski, M. (Inst. of Nuclear Research, Swierk, Poland). Phys. Lett., 27A: 435-6(Aug. 26, 1968).

Investigations of the magnetic field of a spherical high-order multipole are described. The SM system constitutes a minimum-B magnetic trap in which linear loss gaps are replaced by 30 narrow loss cones symmetrically spaced around the effective confinement region. (auth)

44080 CONFINEMENT TIME OF CESIUM AND POTASSIUM PLASMAS IN A Q DEVICE. Motley, R. W.; Jassby, D. L. (Princeton Univ., N. J.). Phys. Lett., 27A: 419-20(Aug. 26, 1968).

The lifetimes of cesium and potassium ions in a Q device are found to be similar, and are several orders of magnitude shorter than the lifetime predicted by charge-exchange mechanisms. (auth)

44081 NUMERICAL EXPERIMENT ON ION CYCLOTRON HEATING. Hasegawa, Akira (Osaka Univ. Nagoya Univ., Japan); Kamimura, Tetsuo. Phys. Fluids, 11: 2004-9(Sept. 1968).

A numerical experiment with a sheet current model is performed to study nonlinear phenomena related to ion cyclotron heating. The model has successfully reproduced damping of ion cyclotron waves at the magnetic beach and consequent heating of ions. Results of the experiment show that the plasma particles are scattered at the beach in the process of the heating. It is also seen that the perpendicular ion temperature increases first and the parallel ion temperature increases some time later. (auth)

44082 MOTION OF TRAVELING PARTICLES IN MINIMUM-B CONFIGURATION. Skosyrev, Yu. V.; Yurchenko, E. I. At. Energ. (USSR), 24: 549-53(June 1968). (In Russian).

To check the feasibility of the minimum-B configuration an apparatus with a helical vacuum chamber and quadropole and hexapolar stabilizing fields was designed. Using an electron gun moving along the helical chamber and a fixed willemite screen the electron action in the given field was studied. The drift surfaces were estimated. The cross section of the drift surfaces coincide with the calculated ones which provide the minimum B in the system. (auth)

44083 EXPERIMENTAL INVESTIGATION OF THE MOTION OF SEPARATE CHARGED PARTICLES IN MAGNETIC MIRROR TRAPS. Ponomarenko, V. G.; Trainin, L. Ya.; Yurchenko, V. I.; Yasnetskii, A. N. (Inst. of Nuclear Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz., 55: 3-13(July 1968). (In Russian).

A decrease of the confinement time of electrons in a trap is found to occur on decrease of the magnetic field strength; it is ascribed to nonconservation of the adiabatic invariant μ. Escape of electrons from the trap during pulsed variation of the magnetic field configuration is observed and ascribed to nonconservation of μ. The appearance of these effects depends on the pressure of the residual gases and on the geometry of the magnetic field lines. The time dependence of the electron magnetic moment spectral distribution is measured. (auth)

Diagnostics of Plasma

Refer also to abstract 43974.

44084 (INR–906) SPECTROSCOPIC MEASUREMENTS OF TEMPERATURE IN INDUCTION PLASMA TORCH. Lesinski, J.; Lewandowski, B.; Suckewer, S. (Institute of Nuclear Research, Warsaw (Poland)). 1968. 16p. (In Polish). Dep.

Results of the studies are described on temperature and electron density distribution in an induction argon plasma torch. Nominal output of the supplying rf generator amounted to 10 kW and its frequency —3 MHz. The temperature of plasma was determined from the absolute intensity of argon atomic lines and from the absolute intensity of continuum radiation. Detailed description of both methods is given. The maximum temperature obtained in the axis of plasma column was 10,350°K and electron density 3.5×10^{17} cm^{-3}. (auth)

44085 (IPP–1/78) MEASUREMENT OF THE ION TEMPERATURE IN THE THETA PINCH ISAR III BY LASER FORWARD SCATTERING. Roehr, H.; Decker, G. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Mar. 1968. 26p. (In German). Dep.

An experiment which allows measurement of a collective scattering spectrum of a plasma in the forward direction (7°) in a single discharge is described. The ion temperatures were determined from the scattering spectra for filling pressures between 10 and 100 μD_2. To improve accuracy, the electron temperature was also measured by a 90° scattering experiment. In all cases, measured spectra agreed within experimental accuracy with those expected of thermal plasmas. The electron temperatures were in all cases approximately 175 eV near the time of maximum B field. However, the ion temperature changed from about 650 eV at 10 mTorr D_2 to about 175 eV at 100 mTorr D_2. This behavior is expected from heating and loss mechanisms characteristic of theta pinches. The ion temperature obtained from neutron measurements (1300 eV at 10 mTorr D_2) is higher than that obtained from the laser scattering experiment. A locally varying ion temperature or superthermal fluctuations could explain the discrepancy. (auth)

44086 (IPP–3/69) ON THE APPLICABILITY OF THE LINE REVERSAL METHOD FOR MEASURING THE ELECTRON TEMPERATURE IN A WEAKLY IONIZED ALKALI SEEDED RARE GAS PLASMA. Brederlow, G.; Riedmueller, W.; Salvat, M. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Feb. 1968. 35p. Dep.

When an electric current is passed through an alkali-metal-seeded rare gas plasma, the electron temperature rises above the gas temperature. This effect was investigated in a streaming argon–potassium plasma at atmospheric pressure and a gas temperature of 2000°K. To measure the electron temperature, the applicability of the line reversal method was investigated. General conditions under which the electron temperature equals the line reversal temperature were derived. In the case studied, the plasma had to be optically thick to the resonance radiation used. The electron temperature was measured with this method as a function of the current density. The results were compared with the values calculated from the theory and those calculated from the measured conductivities. For electron temperatures above 2400°K, all three give the same results. (auth)

44087 (IPP–3/70) INVESTIGATION FOR THE USE OF LECHER WIRE METHOD FOR THE MEASUREMENT OF IONIZATION RATE IN SHOCK HEATED GASES. Siddiqui, A. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Mar. 1968. 33p. (In German). Dep.

The ionization rate in shock-heated gases, i.e., the variation of electron density with time, can be measured with microwave methods. The microwave method developed in the 4-mm region by Makios for similar measurements in a T tube are found very suitable for the present measurements. In this method, microwave power is coupled to a two-wire system, which is stretched through the plasma. It has the advantage of having high spatial resolution. The region of relaxation where atom–atom collisions dominate is of interest for the present measurements. There the ionization coefficient is less than 10^{-5} and the electron density lower than 10^{+12} cm^{-3}. Hence the possibility of use of lecher wire method in the lower frequency range was tested and preliminary measurements in a conventional shock tube in argon were done in 3 cm wavelength range. The advantages and the disadvantages of this method were investigated and coupling systems for wave transformation having low losses were developed. The energy distribution around the wires of different diameter and having different parting distance between them was calculated for the quantitative study of spatial resolution. Almost all the energy flows through a ring having 1-mm radius around the axis of a wire. Due to hypersonic flow, detached bow-shock waves are produced which are 1 mm apart from the wire. Hence practically only the region behind the bow-shock would be measured. This restricts the accuracy of the method to perhaps a factor of two. The wires used have 0.3-mm diameter and are 4 mm apart, the same dimensions as those in a probe method successfully used by Hobson et al. for measurements in a shock tube. The advantages and disadvantages of their method are similar to that described as well as the accuracy. That is a good reason for applying the two methods simultaneously using only one wire system. (auth)

44088 (NP–17560) DAMPING OF THE ULTRAHIGH-FREQUENCY FIELD IN A PLASMA IN CASE OF FIELDS GREATLY EXCEEDING THE CYCLOTRON FIELD. Budnikov, V. N.; Golant, V. E.; Obukhov, A. A. (Akademiya Nauk SSSR, Leningrad. Fiziko-Tekhnicheskii Institut). 1967. 9p. (In Russian). Dep.

During the propagation of plane waves through a homogeneous, cold collision-free plasma, strong absorption may be expected near the resonance region; these considerations may be extended to nonhomogeneous plasmas. This problem was studied experimentally, examining the absorption of ultrahigh-frequency power in a plasma. The authors' earlier experimental system, consisting of a 70-cm long, 2.5 cm wide quartz container, containing hydrogen at a pressure of 10^{-4} to 5×10^{-5} mm of Hg, placed within a 3200 Oersted magnetic field, was used. A rectangular waveguide was used to heat the plasma. Measurements based on the signals plotted as a function of the mean concentration indicated that, as the mean concentration approaches the critical one, the signal is sharply attenuated. This phenomenon is practically pressure independent; thus, collisions do not play any part in it. It was found possible to absorb effectively the ultrahigh-frequency energy by the plasma in a magnetic field exceeding the cyclotron frequency. (TTT)

44089 (NP–17570) STUDIES OF PLASMA PINCH BY REFLECTION OF ULTRAHIGH FREQUENCY WAVES. Ipatov, V. A.; Kaganskii, M. G.; Kalmykov, S. G.; Ovsyannikov, V. A. (Akademiya Nauk SSSR, Leningrad. Fiziko-Tekhnicheskii Institut). 1967. 14p. (In Russian). Dep.

External magnetic field plasma pinch was studied using plasma localization by ultrahigh-frequency wave reflection (microwave diagnostics). Measurements were made of 4- and 8-mm long waves. Observations on the Tuman installation revealed a rapid drop in plasma concentration near the diaphragm during plasma compression. The radius of the plasma cylinder with concentration exceeding 1.7×10^{13} cm^{-3} reduced 3 cm during compression (the diaphragm radius was 6 cm). The drift velocity of critical concentration plasma layers exceeded 2 to 3 times the velocity calculated for conditions with a frozen-in magnetic field. (tr-auth)

44090 (NP–17571) STUDIES OF TURBULENCE OF HIGH-CURRENT TOROIDAL DISCHARGE PLASMA BY MEANS OF ULTRAHIGH-FREQUENCY PROBING METHOD. Larionov, M. M.; Rozhdistvenskii, V. V. (Akademiya Nauk SSSR, Leningrad. Fiziko-Tekhnicheskii Institut). 1967. 14p. (In Russian). Dep.

Data obtained from ultrahigh-frequency probing signal fluctuations were used for evaluating the magnitude of relative electron density fluctuations in plasma. The analysis of the ultrahigh-frequency signal fluctuation level confirmed that the spectrum of electron density fluctuation ranges from tens of kHz up to 2 MHz and over. Multiple scattering in the discharge chamber interfered with the accuracy of determination of electron density fluctuation as a function of frequency. (R.V.J.)

44091 (NP–17587) ELECTRONIC EQUIPMENT FOR MEASUREMENTS OF PLASMA DENSITY AND PLASMA FLUCTUATIONS EXPLORE IN THE STELLARATOR L-I. Akulina, D. K.; Nechaev, Yu. I.; Shpigel, I. S. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). 1968. 16p. Dep.

One of the methods used earlier for plasma density measurements in Stellarator L-1 was a resonator method involving excitation of higher-order modes in the vacuum chamber. A modified circuit diagram was proposed for density measurements. Oscillograms are given showing the decay of plasma density with time. A photoelectric spectrum analyzer for studying fluctuations in the Stellarator is described. (M.O.W.)

44092 (NSJ-tr–122) ON THE ELECTRICAL CONDUCTIVITY OF A WEAKLY IONIZED TURBULENT PLASMA. [PART] I. Nishikawa, Kyoji. Translated from Kakuyugo-Kenkyu, 16: 348-59(1966). 5p. Dep.

On the basis of the magnetohydrodynamic equations, the effect of density fluctuations on the frequency-dependent electrical conductivity of a weakly ionized isothermal plasma is investigated. Only the case in which the magnetic field is static and homogeneous and in which the external electric field is parallel to the magnetic field is considered. The density fluctuations or waves are assumed to be formed by a certain driving force which acts either only on the electrons or only on the ions. The approximations involved are i) the neglect of the inertia term, ii) the neglect of the mode–mode coupling term except when it acts as a driving force and iii) the neglect of the response of the driving force to the external electric field. Some special cases are considered in detail. In particular, when a static density fluctuation is formed by a driving force acting only on the ions, the d.c. conductivity becomes the same as was obtained by Yoshikawa using a more intuitive argument. In general, in the absence of a magnetic field, the effect of fluctuations on the conductivity depends little on whether the driving force is acting on the electrons or on the ions, provided that the characteristic frequencies are much smaller than the electron plasma frequency, but much larger than the ion collision frequency. A difference arises, however, when the magnetic field dependence is considered, i.e., the dependence of the dc current on the magnetic field takes place through the electron cyclotron frequency when the driving force is acting on the ions and through the ion cyclotron frequency when it is acting on the electrons. This difference, however, disappears at high frequencies at which the ions can no longer follow the variation of the external electric field; in this case the magnetic field dependence takes place only through the electron cyclotron frequency. (auth)

44093 (ORO-3405-19) INVESTIGATION OF UNIVERSAL PLASMA INSTABILITIES. Quarterly Report No. 9, December 1, 1967–February 29, 1968. Lashinsky, Herbert (Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics). June 12, 1968. Contract AT(40-1)-3405. 9p. Dep. CFSTI.

Q-machine experiments with the universal drift instability have shown that either discrete or continuous mode spectra may be obtained, depending upon the choice of experimental parameters. "Periodic pulling" has recently been proposed to explain the transition from a discrete spectrum to a continuous spectrum. Work on Q-machine spectra is discussed. (M.O.W.)

44094 DIAGNOSTICS IN FIELD-FREE PLASMAS WITH MEDIUM DISPERSION OPTICAL SPECTROGRAPHIC AND SOURCE MONITORING EQUIPMENT. Hefferlin, R. (Southern Missionary Coll., Collegedale, Tenn. McDonnell-Douglas Corp., St. Louis, Mo.). Progr. High Temp. Phys. Chem., 2: 65-96(1968).

The subject is reviewed under the following main headings: Introduction; measurement of intensity; Abel inversion; specific diagnostic techniques, scan of continuous spectrum, emission and absorptivity measurement, scan of two or more spectrum lines or bands, scan of several spectrum lines of one or more species, traverse of source with spectrograph locked at one wavelength, absolute intensity measurement for given feature and source position, measurement of absorption of light for given feature and source position, determination of line profiles, and use of source monitoring equipment. (UK)

44095 CALCULATION OF THE COMPOSITION OF THE MULTICOMPONENT EQUILIBRIUM PLASMA. Trukhan, E. P. (Inst. of Physics, Minsk). Dokl. Akad. Nauk BSSR, 12: 409-12 (May 1968). (In Russian).

Data are reported on the calculation of the composition of the complex plasma, obtained by the destruction of the walls of the capillary by pulse discharge in the temperature interval from 10,000 to 110,000°K at a pressure of 1 atm. The calculation was made on the assumption of the existence of thermodynamic equilibrium and quasineutral plasma. The temperature dependences of the concentrations of electrons and ions with different ionization multiples were obtained. Curves are shown of the partial pressure of the elements of the plasma, together with those electrons which they give to the plasma. (tr-auth)

44096 REDUCTION OF SHOT NOISE BY COLLISIONS. Fujiwara, M.; Ikezi, H.; Takayama, K. (Nagoya Univ., Japan). Phys. Lett., 27A: 331-2(Aug. 12, 1968).

The shot noise to a probe immersed in a plasma is observed to be reduced by electron–neutral atom collisions in the probe sheath. (auth)

44097 ELECTROSTATIC PROBE MEASUREMENTS IN FLOWING NaK-SEEDED ARGON. McKee, Harris B.; Mitchner, M. (Stanford Univ., Calif.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 1587-9(Aug. 1968).

Current–voltage characteristics were obtained using a cooled cylindrical probe in a low-velocity atmospheric-pressure flow of argon seeded with NaK (90% K by weight). (TSS)

44098 INVESTIGATION OF TURBULENT PLASMA BY MEANS OF INCOHERENT SCATTERING OF MICROWAVES. Malykh, N. I.; Perepelkin, N. F.; Utkina, L. A.; Yampol'skii, E. S. At. Energ. (USSR), 25: 3-9(July 1968). (In Russian).

The oscillations excited in the plasma θ-pinch experiment in the static magnetic field were investigated. The microwave epithermal radiation spectrum was studied and the effect of incoherent scattering of microwaves by electron (Langmuir) and ion–acoustic oscillations of plasma was observed. (auth)

44099 INVESTIGATION OF THE HELIUM AFTERGLOW. I. MASS SPECTROMETRIC OBSERVATIONS. Smith, D.; Copsey, M. J. (Univ. of Birmingham, Eng.). J. Phys., B, 1: 650-9 (July 1968).

Mass-spectrometric observations of helium afterglows by ion sampling from the walls of a large discharge vessel are described. It is shown that, in very pure cataphoretically cleaned helium in the pressure range 0.3 to 2 torr, the only important processes occurring in the late afterglow are ambipolar diffusion of atomic and molecular ions and electrons, and conversion of atomic to molecular ions by three-body collisions with neutral helium atoms. The atomic and molecular ion mobilities corresponding to the observed diffusion rates are, respectively, 11.2 ± 0.4 $cm^2\ v^{-1}\ s^{-1}$ and 15.9 ± 0.4 $cm^2\ v^{-1}\ s^{-1}$, in acceptable agreement with several previous mobility measurements, and the value obtained for the three-body conversion coefficient, 85 ± 3 $torr^{-2}\ s^{-1}$ (pressure reduced to 0°C) is in good agreement with a recent similar measurement by other workers in a higher-pressure range. The wall temperature of the discharge vessel during these measurements was 295°K. Measurements carried out in helium samples which were not subjected to cataphoretic purification demonstrated the serious effect of small amounts of impurity on the decay rate of the molecular helium ion. (auth) (UK)

44100 INVESTIGATION OF THE HELIUM AFTERGLOW. II. LANGMUIR PROBE OBSERVATIONS. Smith, D.; Goodall, C. V.; Copsey, M. J. (Univ. of Birmingham, Eng.). J. Phys., B, 1: 660-8(July 1968).

Measurements are described of slow electron density decay rates in pure helium afterglow plasmas, using a very small single Langmuir probe, a technique not hitherto applied to the study of ambipolar diffusion. Values are obtained for the rate of conversion of He^+ ions to He_2^+ ions and for the respective mobilities of these ions at a wall temperature of 295°K, in reasonable agreement with values obtained by other workers using different techniques. This agreement is considered to indicate that depletion problems, which are expected to be more severe in slowly decaying plasmas, have been overcome by the utilization of very small probes. Evidence is also presented for the existence of elevated electron temperatures at times as late as 10 ms in the afterglow, and these results, together with the foregoing are critically discussed and compared in detail with the complementary mass spectrometric observations described in Part I. (auth) (UK)

44101 DECAY OF A HIGHLY IONIZED HELIUM PLASMA. Newton, A. A.; Sexton, M. C. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). J. Phys., B, 1: 669-80(July 1968).

Laser and microwave interferometers were used to measure electron densities over the range 1.8×10^{15} to 8×10^{11} cm^{-3} in a decaying helium plasma without a confining magnetic field, at gas pressures ranging from 82 to 1200 mtorr. Collisional radiative recombination and ambipolar diffusion were identified as the electron-loss mechanisms, with the former dominating at the highest pressures and densities. Spectroscopic measurements of electron temperature were in good accord with the recombination coefficients α inferred from theory, but the actual trend of α with density suggested the existence of elevated atom and ion temperatures. The loss of recombination energy from the plasma was mainly due to radiation and atom thermal conduction, but the electron–atom energy coupling in helium was sufficient to permit the latter mechanism only at the highest electron densities. The assumption of elevated ion temperatures also led to good agreement between the theoretical and experimental diffusion coefficients. (auth)(UK)

44102 MEASUREMENT OF THE ELECTRON CONCENTRATION IN A PLASMA FORMED BY A FAST ELECTRON BEAM. Kolosov, A. V. Zh. Prikl. Mekh. Tekh. Fiz., No. 1, 114-16 (Jan.-Feb. 1968). (In Russian).

For certain applications, the changes in the volume occupied by the plasma must be known. The available experimental data refer to the ionization of rarified gases by pulsed beams of a few microsecond duration; under such conditions, ionization processes play an important role in the formation of the plasma but the information obtained does not apply to ionization by a stationary electron beam. For this reason, the concentration of electrons in plasmas created by the ionization of the gas—air, helium, or argon—by a 0.1- to 0.6-mA, fast electron beam was measured by means of an ultrahigh-frequency resonator method in the 3-cm wavelength band. It was found that in that range, the electron concentration increases linearly with increasing beam current; a similar correlation was also found for pressure. Comparison of the curves of the 3 gases revealed that the electron concentration in helium is lower, and in argon it is higher than in air under identical conditions of beam current and pressure. The plasma's electron concentration was between 2×10^{10} and 10^{12} electron cm^{-3}, exceeding the concentration of primary electrons in the beam. This range may be broadened by changing the current and gas pressure. (TTT)

44103 RADIAL DENSITY DISTRIBUTION IN A WIDE UNSTABLE PLASMA COLUMN. Ventrice, Carl A.; Massey, C. G. (Auburn Univ., Ala.). Phys. Fluids, 11: 1990-4(Sept. 1968).

The positive column of an argon discharge is investigated in the presence of a longitudinal magnetic field using a triple electrostatic probe. A wide chamber with a magnetic field length to radius ratio of six is used. The existence of an instability is confirmed. The variation of the radial density distribution with magnetic field is observed to be in qualitative agreement with the theory of Holter and Johnson. In addition, the electron temperature is observed to increase with increasing magnetic field. Repeated experiments show that the instability does not always develop even when the magnetic field is increased to six times the theoretical value of the critical field. Under this condition the variation of the radial density distribution with magnetic field is observed to be in qualitative agreement with the results of Bickerton and von Engel. (auth)

44104 MICROWAVE MEASUREMENTS OF HIGH ELECTRON DENSITIES USING THE COMPLEX REFLECTION COEFFICIENT. Kinney, Ralph A. (Louisiana State Univ., Baton Rouge). IEEE (Inst. Elec. Electron. Eng.) Trans. Nucl. Sci., NS-15: No. 4, 6-13 (Aug. 1968).

The determination of electron densities in the high density range has become increasingly important in recent years and the use of the complex reflection coefficient at microwave frequencies as a plasma diagnostic tool has been reported by several authors. However, the sensitivity of the reflected phase to the electron density profile composing the boundary of the plasma reduces the effectiveness of the sharply bounded uniform slab as a plasma model. Since this model finds frequent use, the resultant errors should be considered. Indeed, even when the width of the electron-gradient boundary zone is very small, serious error in the determination of the plasma number density can occur when the reflection coefficient is used. A method is suggested by which electron-gradient-induced errors in number density calculations can be overcome. Briefly, it is shown that if measurements of the complex reflection coefficient can be made at several frequencies, the data can be extrapolated to find the electron density in a uniform plasma region regardless of the width of the boundary zone of the plasma or the associated plasma density profile. The region where $\omega_p > \omega$ is emphasized. (auth)

44105 RELATIVISTIC DOPPLER BROADENING DIAGNOSTICS. Censor, Dan (Univ. of Illinois, Chicago). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-15: No. 4, 27-32(Aug. 1968).

The theory of the Doppler broadening of radiated or backscattered monochromatic waves is investigated. A simple idealized model is discussed, to show that the classical theory of correlating the frequency spectrum with the line-of-sight velocity distribution is inadequate. It is demonstrated that relativistic considerations yield first-order effects which exist even for low velocities. Consequently, if the spectral and velocity-distribution profiles are compared, the spectral curve shows de-emphasis and pre-emphasis for lower and higher frequencies, respectively. Experimental evidence supports the theory. (auth)

44106 MEASUREMENT OF THE ELECTRON DENSITY IN A PLASMA PRODUCED BY A BEAM OF FAST ELECTRONS. Kolosov, A. V. Zh. Prikl. Mekh. Tekh. Fiz., No. 1, 114-16 (1968). (In Russian).

A measurement was made of the density of electrons produced by ionization of the gas by a beam of fast electrons, with a beam current ranging from 0.1 to 0.6 mA, for three different gases (air, helium, and argon). The measured electron density was averaged over the cross section of the discharge column. The measurement was based on determining the complex conductivity of the plasma by a microwave cavity method at 3-cm wavelength. The density was determined from the change of the transfer coefficient and from the shift of the resonant line of the cavity when the electron beam passed through it. The density, for different pressures and for different currents, was $\sim 2 \times 10^{10}$ electrons/cm^3 as against about 2×10^7 in the absence of ionization. It is thus demonstrated that a beam of electrons can produce a plasma whose electron density can be varied over a wide range by choosing the proper gas, by varying the gas pressure, by varying the beam current, and by varying the beam accelerating voltage. Plots of density for different variations of the parameters are presented. (ATD)

44107 MEASUREMENT OF ELECTRON DENSITY BY SURFACE WAVES. Ilic, Dragan (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Bull. Boris Kidric Inst. Nucl. Sci., Phys., 18: No. 4, 37-41(Nov. 1967).

Quasi-static theory is presented for an axially symmetric TM surface mode propagating along a homogeneous plasma column contained in a cylindrical glass tube of circular cross section. The resulting dispersion relation is evaluated and a collection of curves is obtained for various thicknesses of glass tube. The dispersion relation is verified experimentally and electron density is measured using surface waves in the frequency range from 110 to 250 MHz and densities from 1.6×10^9 to 12.5×10^9 el/cm^3. (auth)

44108 LINE PROFILES OF Ar II OBSERVED IN A FLUTE PLASMA JET OF ARGON. Chapelle, Joseph; Sy, Alassane; Cabannes, Francois; Blandin, Jean (Faculte des Sciences, Dakar-Fann, Senegal. CNRS, Bellevue, France). Compt. Rend., Ser. A and B, 266: 1513-16(June 17, 1968). (In French).

The experimental line profiles of Ar II are compared with the Stark profiles proposed by Griem; it is verified that these are dispersion profiles. (tr-auth)

44109 THEORY OF HOT DIFFUSION PROBES. Zherebtsov, V. A. (Physics-Energetics Inst., USSR). Teplofiz. Vys. Temp., 6: 14-22(Jan.-Feb. 1968). (In Russian).

Spherical and cylindrical probes emitting ions and electrons were examined. The probe radius is much larger than the length of the free path of the plasma particles. Equations for the volt-ampere characteristics were obtained. A method was proposed for their design when the ion emission can be neglected. (tr-auth)

Kinetics of Plasma

Refer also to abstracts 42935, 43966, 43967, and 44066.

44110 (IPP-6/62) THE NONLINEAR INTERACTION OF A STEADY-STATE CIRCULARLY POLARIZED ELECTROMAGNETIC WAVE WITH A COLD PLASMA IN A CONSTANT LONGITUDINAL MAGNETIC FIELD. Luenow, Werner (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Jan. 1968. 32p. (In German). Dep.

The strictly relativistic, nonlinear solution describing the interaction of a stationary, circularly polarized electromagnetic wave with a cold plasma in a constant longitudinal magnetic field is derived. Apart from the a priori restriction that the plasma in the wave–plasma–magnetic field system under consideration be cold, no other restriction is imposed on the range of validity of the solution. Provided the solution exists, it is thus valid for any values of the parameters. The solution allows exact study of the resonance behavior and cutoff behavior of wave–plasma–magnetic field systems of the kind described. The nonlinear relations between the wave, plasma, and field parameters can be solved numerically without approximations. Owing to the complicated nature of the equations, a special case is treated which at least conveys some idea of the general relationships. (auth)

44111 (IS-Trans-76) ON COMPLETENESS OF VAPORIZATION DURING BLOWING-IN (INSUFFLATION) OF POWDERED MATERIALS INTO THE PLASMA OF AN ELECTRICAL DISCHARGE. Tumanov, A. K. Translated by E. E. Conrad (Ames Lab., Iowa), from Zh. Prikl. Spektrosk., 6: 285(1967). 9p. Dep. CFSTI.

During investigation of the insufflation method it was established that the completeness of particle vaporization is increased with increased duration of single discharge action. Recommendations about the arrangement of the electrical system of the source and conditions of analysis are presented, directed toward increasing or decreasing the degree of vaporization. (auth)

44112 (NP-17460) DISKUSSION DER STRAHLUNGSTRANSPORTGLEICHUNG IN VERSCHIEDENEN KOORDINATENSYSTEMEN. (Discussion of the Radiation Transport Equation in Different Coordinate Systems). Report No. 1-26. Moser, F.; Froehlich, G. (Technische Hochschule, Stuttgart (West Germany). Institut fuer Plasmaforschung). Dec. 1967. 16p. (In German). Dep.

The radiation transport equation for spatially expanded radiation sources is derived and discussed. The equation is given completely for the following geometries: a plasma channel with rectangular cross section, a plasma cylinder with circular cross section, and a plasma sphere. The scattering in plasma was not considered. (tr-auth)

44113 (NP-17575) KINETIC EQUATIONS FOR ELEMENTARY EXCITATIONS AND NONLINEAR INTERACTIONS OF

WAVES IN PLASMA. Preprint No. 12. Tsytovich, V. N. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). 1968. 131p. (In Russian). Dep.

A brief review is given of the basic aspects of the theory of nonlinear wave interactions in plasma. Kinetic plasmon equations, probabilities of interaction processes, and interactions between plasmons and particles are discussed. Uses of the collective excitation method in various problems of turbulent plasma physics — turbulent heating and stochastic particle acceleration, anomalous turbulent plasma radiation, nonlinear effects in electron cyclotron heating processes, nonlinear turbulence generation by electromagnetic waves, and electromagnetic wave scattering on turbulent plasma pulsations — are discussed. (93 references). (R.V.J.)

44114 (NP–17581) STUDIES OF MECHANISMS OF PLASMA JET CUT OFF BY TRANSVERSE MAGNETIC FIELDS. Preprint No. 31. Gol'ts, E. Ya.; Khodzhaev, A. Z. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). 1968. 54p. (In Russian). Dep.

Physical processes in producing short hydrogen plasma clusters by the cutoff part of plasma jets were investigated. A special device was constructed for determining the longitudinal and transverse polarization of plasma and capture and reflection by magnetic fields. The design and performance of the device are described and probe descriptions are given of reflection, capture, and penetration of plasma through the device gate. Measurement of angles of deflection of ions passing through the gate is discussed. (R.V.J.)

44115 (NP–17582) ELECTRODYNAMIC STUDIES ON WAVES IN A SYSTEM OF TWO ELECTRONIC COUNTERSTREAMS AND A PLASMA. Jarmen, Anders (Uppsala Univ. (Sweden)). 1968. 117p. Dep.

Thesis.

The system studied is a parallel plate waveguide filled with a symmetrically located slab composed of a plasma and two counterstreaming electron beams in a background of neutralizing ions. The areas investigated are the following: (1) the cold and unmagnetized system, (2) unmagnetized system with a hot background plasma, (3) the longitudinally magnetized system with a hot background plasma, and (4) nonlinear waves. (M.O.W.)

44116 (SC-RR–68–284) HIGH-FREQUENCY ELECTRICAL BREAKDOWN OF THERMALLY IONIZED GASES. Russo, A. J. (Sandia Corp., Albuquerque, N. Mex.). May 1968. Contract AT(29-1)-789. 62p. Dep. CFSTI.

An expression for the steady-state ionization of a hot gas in the presence of a weak electric field is derived from statistical principles and is applied to air in the temperature range of 3000 to 5000°K. An alternate way of determining the breakdown field strength in cold gases by using the electron temperature as an indicator is investigated for air, neon, and helium. The electron temperature is calculated from the electron distribution function which is obtained by the solution of the linearized Boltzmann equation. (auth)

44117 PROPAGATION AND LINEAR AMPLIFICATION OF A WAVE IN A PLASMA–ELECTRON BEAM SYSTEM CONFINED BY A MAGNETIC FIELD. Bouchoule, Andre; Weinfeld, Michel (CNRS, Orsay, France). Compt. Rend., Ser. A and B, 266: 1408-11(June 5, 1968). (In French).

A plasma column placed in a magnetic field can propagate an electron space charge wave whose phase velocity v_ϕ is very small relative to the speed of light. This wave can be amplified by a beam of electrons of velocity U_0 slightly greater than v_ϕ. This fact is frequently verified experimentally, but almost always in a qualitative way; in verifying this for $U_0 \geq v_\phi$, one obtains an amplification. The purpose of the investigation is to verify from sufficiently well-defined experimental conditions, similar to those which must be imposed in order to carry out a complete theoretical calculation, the agreement between experiment and theory. (tr-auth)

44118 ANALYSIS OF THE DISPERSION EQUATION FOR A BEAM–PLASMA SYSTEM CONFINED IN A MAGNETIC FIELD. Kotsarenko, N. Ya.; Fedorchenko, A. M. (Kiev State Univ.). Radiotekh. Elektron., 13: 938-40(May 1968). (In Russian).

Earlier calculations by a quasistatic approximation yielded the dispersion equation for waves propagating in a cylindrical plasma waveguide with an external magnetic field. An approximation method was developed to resolve this 6th degree equation. The results indicated that two types of amplification are involved in this system: a mechanism involving the interaction of the cyclotron wave with the slow electromagnetic wave and another one similar to the beam amplification described by other authors for the nonconfined plasma–beam system. (TTT)

44119 ION SOUND EXCITATION IN A DIRECTION PERPENDICULAR TO THE CURRENT. Aleksandrov, A. F.; Kuzovnikov, A. A.; Sviridkina, V. S.; Tarasova, V. V. Radiotekh. Elektron., 13: 953-4(May 1968). (In Russian).

Experiments were carried out to determine the feasibility of exciting ion-sound waves by means of an external high-frequency field, placed perpendicularly with respect to the direction of the current in the plasma. A rectangular discharge tube containing mercury vapors at pressures of 3×10^{-3} and 3×10^{-4} mm of Hg was placed between the plane condenser used to create the high-frequency field. The distribution of oscillations in the plasma upon application of the high-frequency field was investigated by means of a photomultiplier; the frequency of the applied field varied from 1 to 30 kHz. At nearly all frequencies it was found that the oscillations were localized in narrow zones near the boundary of the plasma, with a phase difference of π. It was concluded that the distribution is related to the polarization of the plasma in the external high-frequency field. The observed resonance was attributed to the ion–sound resonance of the plasma layer. (TTT)

44120 ULTRASONIC WAVE AMPLIFICATION IN GASEOUS PLASMAS. Yatsui, Kiyoshi (Osaka Univ.); Kobayashi, Tohru; Inuishi, Yoshio. Technol. Rep. Osaka Univ., 18: 131-42(Mar. 1968).

Sound wave - plasma interaction was experimentally investigated in gases using ultrasonic tranducers and spatial growth or damping rate of sound waves was studied for various plasma parameters. It was found that ultrasonic waves travelling in gaseous plasmas can be amplified with its maximum gain of about 10 dB for dc operation under certain experimental conditions. Propagation velocity of these waves was also examined using pulse packet techniques and it turns out that this amplification phenomenon is presumably due to the energy transfer from electrons accelerated by electric field to neutral particles in density wave through these dominated electron–neutral collisions. (auth)

44121 STUDIES OF NON-LINEAR EFFECTS DURING WAVE PROPAGATION IN PLASMA CONSIDERING THE BOUNDARIES. Chakraborti, B. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 5, 99-105(Sept.-Oct. 1967). (In Russian).

Vlasov equations were used for resolving the problem of nonlinear effects in the plane of the vacuum - plasma interface boundary. A plane monochromatic wave with oblique incidence to the vacuum was the source of perturbation in the plasma. (R.V.J.)

44122 DISPERSION EQUATION FOR HIGH FREQUENCY WAVES PROPAGATING IN INHOMOGENEOUS ANISOTROPIC PLASMA. Strezh, P. E. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 5, 123-5(Sept.-Oct. 1967). (In Russian).

A dispersion equation was obtained for high-frequency small-amplitude waves propagating in a semi-space filled with a heterogeneous anisotropic plasma, having slowly changing parameters along the length of the propagating wave. The solution was limited to completely ionized plasma without consideration for ion motion. The dispersion equation obtained is not limited to only plane structure waves but may be used in linear approximations of high-frequency processes in various heterogeneous plasma media with parameters assigned as specific function coordinates. (R.V.J.)

44123 THERMODYNAMICS AND MAGNETOHYDRODYNAMICS OF WAVE PROPAGATION IN PARTIALLY IONIZED PLASMAS. Kirsten, E. (Karl-Marx-Univ., Leipzig); Vojta, G. Monatsber. Deut. Akad. Wiss. Berlin, 9: 666-70(1967). (In German).

A dynamic adiabatic state equation for a partially ionized plasma with three components was derived in the framework of the thermodynamics of irreversible processes. The ionization degree is time dependent and shows relaxation. For such a plasma set of generalized magnetohydrodynamic equations was derived and solved after linearization. Dispersion relaxations which contain all possible wave types are given and are modified through terms in which the mean ionization degree, the ionization energy, the mean temperature, and the relaxation time are introduced. (tr-auth)

44124 DESTRUCTION OF METALS BY PULSE PLASMA JET. Morozov, V. A.; Kiselevskii, L. I. (Inst. of Physics, Minsk). Dokl. Akad. Nauk BSSR, 12: 413-16(May 1968). (In Russian).

The destruction of metals under the effects of pulsed plasma jets of capillary discharge was examined. The discharge energy was varied from 50 to 1800 joules. Supersonic plasma jets had Mach numbers from 1.5 to 5. At discharge energy below 200 joules the extrusion of liquid metal from erosion pits began and it solidified in the form of concentric rolls. In general, the erosion became substantially a part of the vapor phase. With increase of the discharge energy the erosion took place in the liquid phase. Multiple tracks of the emitted particles were seen. These particles were ejected from the erosion pits in the liquid state, were cooled, and were broken up into very finely divided fragments. (tr-auth)

44125 EMISSIVE PROPERTIES OF SOME GASES IN THE HIGH TEMPERATURE RANGE FROM 6000 TO 12000°K. Moskvin, Yu. V. Teplofiz. Vys. Temp., 6: 1-9(Jan.-Feb. 1968). (In Russian).

A theoretical study was made of the emissive properties of hydrogen, ammonia, water, argon, and helium in the temperature range from 6,000 to 12,000°K, at 2000°K intervals. In the case of hydrogen the pressure range studied was from 1 to 1000 atm and from 0.1 to 100 atm for the other gases. The calculation results are tabulated, and the data on hydrogen were approximated with a precision from 10 to 20% of the analytical expressions. The results of the experimental study of the emission of argon at atmospheric pressure in the temperature range from 9,000 to 11,000°K were reported. (tr-auth)

44126 DEPENDENCE OF THE TEMPERATURE AND PRESSURE OF THE PLASMA OF A CAPILLARY DISCHARGE WITH EVAPORATING WALL ON THE GEOMETRY OF THE CAPILLARY AND THE DISCHARGE CURRENT. Ogurtsova, N. N.; Pobmoshenskii, I. V.; Shelemina, V. M. Teplofiz. Vys. Temp., 6: 48-53(Jan.-Feb. 1968). (In Russian).

A spectroscopic study was made of the capillary discharge with evaporating wall. In the temperature region from 10,000 to 200,000°K, pressure region from 10^5 to 5×10^7 n/m^2, and electron concentrations from 10^{17} to 10^{20} cm^{-3}, the dependencies of the temperature and pressure of the gas-discharge plasma on the geometry of the capillary and the discharge current were experimentally obtained. It is shown that the capillary discharge with evaporating walls makes it possible to obtain for a sufficiently long time a quasi-stationary, homogeneous plasma of given chemical composition in a wide temperature and pressure region. (tr-auth)

44127 METHOD FOR THE CALCULATION OF THE CHARACTERISTICS OF ARCS IN CHANNELS. Zarudi, M. E. (Union Scientific Research Inst. of Electrothermal Plants, USSR). Teplofiz. Vys. Temp., 6: 35-43(Jan.-Feb. 1968). (In Russian).

The known methods for the calculation of the characteristics of columns of direct current arcs, stabilized by the walls of the cylindrical channels, were analyzed. It was shown that the approximation calculation of the arc parameters are possible on the basis of assumptions on the uniform distribution of the thermal sources in the conducting region. From the development of this idea comes the method of stepwise approximation permitting the solution of the nonideal differential equation of the energy balance to lead to a system of recurrent relations. The comparison of the methods was made on the example of the calculation of the arc parameters in argon atmosphere at $p = 10^5$ nm^{-2}. (tr-auth)

44128 ELECTRIC ARC IN A CURRENT OF ARGON WITH CESIUM IN THE PRESENCE OF A MAGNETIC FIELD. Baranov, V. Yu.; Ul'yanov, K. N. (Lenin Union Electrotechnical Inst., USSR). Teplofiz. Vys. Temp., 6: 23-9(Jan.-Feb. 1968). (In Russian).

It was experimentally shown that the density of charged particles in an arc column is altered as a function of the pressure of argon and cesium, that is, the degree of contraction. The blowing-out and blowing-in regimes of the flow channels are possible during the superposition of both delaying and accelerating magnetic fields. (tr-auth)

44129 THEORY OF MICROFIELDS IN PLASMA. Selibovkin, A. D. (Inst. of Atomic Energy, Moscow). Teplofiz. Vys. Temp., 6: 10-13(Jan.-Feb. 1968). (In Russian).

The conditions for the development of Gaussian-type distribution of microfields in plasma (and not Holtsmark as usual) were examined. It was shown that the Gaussian distribution is developed in the cases when the transfers of the plasma particles are substantially limited (case of weak fluctuating configurations of the particles, responding to very dense plasma). Two cases were analyzed as examples: Mayer case ($N_D \ll 1$, where N_D is the number of particles in a sphere of Debye radius) and the case of very high density when the finiteness of the ion dimensions play a basic role. (tr-auth)

44130 INVESTIGATIONS OF GAS-CONDITIONS IN THE OPERATION OF A COAXIAL PLASMA INJECTOR. Kozlowski, Zbigniew; Sadowski, Marek (Inst. of Nuclear Research, Swierk, Poland). Nukleonika, 13: 645-62(1968).

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sion became substantially a part of the vapor phase. With increase of the discharge energy the erosion took place in the liquid phase. Multiple tracks of the emitted particles were seen. These particles were ejected from the erosion pits in the liquid state, were cooled, and were broken up into very finely divided fragments. (tr-auth)

44125 EMISSIVE PROPERTIES OF SOME GASES IN THE HIGH TEMPERATURE RANGE FROM 6000 TO 12000°K. Moskvin, Yu. V. Teplofiz. Vys. Temp., 6: 1-9(Jan.-Feb. 1968). (In Russian).

A theoretical study was made of the emissive properties of hydrogen, ammonia, water, argon, and helium in the temperature range from 6,000 to 12,000°K, at 2000°K intervals. In the case of hydrogen the pressure range studied was from 1 to 1000 atm and from 0.1 to 100 atm for the other gases. The calculation results are tabulated, and the data on hydrogen were approximated with a precision from 10 to 20% of the analytical expressions. The results of the experimental study of the emission of argon at atmospheric pressure in the temperature range from 9,000 to 11,000°K were reported. (tr-auth)

44126 DEPENDENCE OF THE TEMPERATURE AND PRESSURE OF THE PLASMA OF A CAPILLARY DISCHARGE WITH EVAPORATING WALL ON THE GEOMETRY OF THE CAPILLARY AND THE DISCHARGE CURRENT. Ogurtsova, N. N.; Pobmoshenskii, I. V.; Shelemina, V. M. Teplofiz. Vys. Temp., 6: 48-53(Jan.-Feb. 1968). (In Russian).

A spectroscopic study was made of the capillary discharge with evaporating wall. In the temperature region from 10,000 to 200,000°K, pressure region from 10^5 to 5×10^7 n/m^2, and electron concentrations from 10^{17} to 10^{20} cm^{-3}, the dependencies of the temperature and pressure of the gas-discharge plasma on the geometry of the capillary and the discharge current were experimentally obtained. It is shown that the capillary discharge with evaporating walls makes it possible to obtain for a sufficiently long time a quasi-stationary, homogeneous plasma of given chemical composition in a wide temperature and pressure region. (tr-auth)

44127 METHOD FOR THE CALCULATION OF THE CHARACTERISTICS OF ARCS IN CHANNELS. Zarudi, M. E. (Union Scientific Research Inst. of Electrothermal Plants, USSR). Teplofiz. Vys. Temp., 6: 35-43(Jan.-Feb. 1968). (In Russian).

The known methods for the calculation of the characteristics of columns of direct current arcs, stabilized by the walls of the cylindrical channels, were analyzed. It was shown that the approximation calculation of the arc parameters are possible on the basis of assumptions on the uniform distribution of the thermal sources in the conducting region. From the development of this idea comes the method of stepwise approximation permitting the solution of the nonideal differential equation of the energy balance to lead to a system of recurrent relations. The comparison of the methods was made on the example of the calculation of the arc parameters in argon atmosphere at $p = 10^5$ nm^{-2}. (tr-auth)

44128 ELECTRIC ARC IN A CURRENT OF ARGON WITH CESIUM IN THE PRESENCE OF A MAGNETIC FIELD. Baranov, V. Yu.; Ul'yanov, K. N. (Lenin Union Electrotechnical Inst., USSR). Teplofiz. Vys. Temp., 6: 23-9(Jan.-Feb. 1968). (In Russian).

It was experimentally shown that the density of charged particles in an arc column is altered as a function of the pressure of argon and cesium, that is, the degree of contraction. The blowing-out and blowing-in regimes of the flow channels are possible during the superposition of both delaying and accelerating magnetic fields. (tr-auth)

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Two methods have been proposed for the direct oscillographic display of the electron-density variations and of the electron-temperature variations in a plasma. The validity of these measuring techniques in the actual experimental discharge conditions is considered. (auth)

44151 PLASMA VIRIAL AND EQUATIONS OF STATE FOR A PLASMA. Liboff, Richard L.; Lie, Tae-Journ (Cornell Univ., Ithaca, N. Y.). Phys. Fluids, 11: 1943-50(Sept. 1968).

The virial theorem for a plasma is formulated within a particle framework. The result is applicable to isotropic, anisotropic, and quasirelativistic systems. The form reveals the negative quality of the time derivative of the virial in addition to the structure of the particle–particle inductance tensor. A tensoral virial theorem is formulated for anisotropic systems. Equations of state for magnetoactive idealized plasma configurations are derived. (auth)

44152 EFFECTIVE PARAMETERS FOR MAXWELLIAN AND NON-MAXWELLIAN MAGNETOPLASMAS. Bakshi, P. M.; Haskell, R. E.; Papa, R. J. (Air Force Cambridge Research Labs., Bedford, Mass.). Can. J. Phys., 46: 1547-62(July 1, 1968).

The velocity dependence of the electron–neutral collision frequency may be taken into account by introducing an effective collision frequency and an effective plasma frequency. The properties of these effective parameters are examined for cold, weakly ionized magnetoplasmas. The relationship between these effective parameters and a new collisional response function R(y) is described for Maxwellian distribution functions. For this case of Maxwellian distributions, curves are presented of the effective parameters as a function of frequency for both a pure power-law dependence of collision frequency on electron velocity and for the case of a coupling between two power-law variations. When the ac electric field becomes sufficiently strong to alter the form of the isotropic part of the electron distribution function, the effective plasma parameters will become functions of the ellipticity and intensity of the ac field. Graphs are presented of the effective parameters as a function of normalized frequency, normalized field strength, and dependence of collision frequency on electron velocity for the case where only pure (unmixed) high-intensity modes are present in the weakly ionized magnetoplasma. (auth) (Canada)

44153 CONVERSION RATES AND ION MOBILITIES IN PURE NEON AND ARGON AFTERGLOW PLASMAS. Smith, D.; Cromey, P. R. (Univ. of Birmingham, Eng.). J. Phys., B, 1: 638-49 (July 1968).

Measurements were made at room temperature of the rates of decay of the atomic ion species in afterglow plasmas in pure neon and argon at various pressures within the range 0.01 to 2 torr. In both gases the variation of the measured decay rates with pressure, observed over about two orders of magnitude in pressure, was consistent with the loss of the atomic inert gas ions by diffusion to the plasma boundary and by conversion to molecular inert gas ions in three-body reactions with the neutral gas. The measurements constitute the first observations of the three-body conversion process in argon by a method providing mass identification of the participating ion species. These results are compared with the values which have been obtained by other workers, and comparisons are also made with the existing theoretical estimates of the measured parameters. (auth) (UK)

44154 HEAT LOSSES IN A PULSED PLASMA ACCELERATOR. Rushailo, A. M. Zh. Prikl. Mekh. Tekh. Fiz., No. 1, 117-20(Jan.-Feb. 1968). (In Russian).

The author reported earlier that heat losses and the current density are unevenly distributed in the pulsed, coaxial, electromagnetic plasma accelerator. Further study revealed that this homogeneity is the chief reason of the great heat losses experienced in the system. It was found possible to reduce the losses at the accelerating electrodes and to increase the efficiency of the accelerator from 45% to 60% by reducing the uneven charge distribution. The experiments were carried out at a discharge current of 80 to 450 kA, with a half-period of 3.4×10^{-5} sec and a mean plasma velocity of 4 to 8×10^{6} cm/sec, under condition of a single discharge in the vacuum chamber at an operating pressure of 5×10^{-5} to 10^{-4} mm of Hg. The discharge was initiated by a movable electrode receiving the high voltage pulse. The energy of the plasma jet was determined by means of a calorimeter placed 1 cm from the exit point of the accelerating electrons. A change of the longitudinal nonhomogeneity of the current distribution, achieved by moving the quartz insulator from the narrow neck, reduced the losses. (TTT)

44155 LOW-FREQUENCY PLASMA OSCILLATIONS IN PLANE DIODES. Gordeev, G. V. Zh. Prikl. Mekh. Tekh. Fiz., No. 1, 120-3(Jan.-Feb. 1968). (In Russian).

The low-frequency oscillations of plasma in plane diodes were investigated by investigating its kinetic equation, taking into account the symmetry of the boundary conditions at the confines of the plasma electrode barriers. It was found that the waves moving from the cathode toward the anode may be excited at lower electron velocities than in the case of an unconfined plasma. This is due to the waves reflected by the electrodes. Calculations were made to derive the conditions which create undampened oscillations in the plasma at wavelengths equal to the distance between the electrodes. It was found that consideration of the confines of the plasma on the oscillations within it brings the results of the theory close to the experimental data. (TTT)

44156 KINETIC COEFFICIENTS OF THE MULTICOMPONENT NONISOTHERMAL PLASMA. Kirii, I. Yu.; Silin, V. P. Zh. Prikl. Mekh. Tekh. Fiz., No. 1, 112-13(Jan.-Feb. 1968). (In Russian).

The increment of the Coulomb logarithm of viscosity and thermal conductivity of a two-component, fully ionized, nonisothermal plasma, reflecting the effect of polarization on the kinetic coefficients, exceeds the corresponding value of friction coefficients of electrons and ions. The increment is due to the interaction of electrons with ion-acoustic oscillations of the nonisothermal plasma. On this basis, a three-component nonisothermal plasma with two types of ions was investigated, determining the velocities of acoustic waves and their spectrum. The "damping," i.e., the interaction of particles with waves, was found to be caused by electrons and fast ions. An expression was derived to determine the friction forces of electrons and fast ions. The second term of the expression obtained is due to the interaction of particles with sound waves of the spectrum. The derivations showed that under certain conditions, the conductivity in a three-component plasma is due not to particle collisions but to the interchange of acoustic waves with electrons and fast particles, representing polarization effects of the plasma. (TTT)

44157 STRUCTURE OF THE VISCOUS ISOELECTRON-TEMPERATURE DISCONTINUITY IN PLASMA. Imshennik, V. S. Zh. Prikl. Mekh. Tekh. Fiz., No. 1, 13-25(Jan.-Feb. 1968). (In Russian).

At high Mach numbers, the shock wave in a plasma exhibits a discontinuous structure, with jumpwise changes in the ion temperature, density and velocity, while the electron temperature stays constant. The main mechanism involved in the compression and heating of the plasma in this viscous isoelectron temperature jump is the viscosity of the plasma, caused by ion collisions. In order to gain additional information on this subject, the structure of the discontinuity was investigated, considering specifically the ion viscosity of the plasma; the ionic heat conductivity may be neglected. The entropy of the gas within the discontinuity range is uneven. The total entropy, based on the sum of the entropy of ions and electrons was found to present a maximum within the discontinuity. Study of the structure lead to a stationary solution of a system of three nonlinear differential equations which determine the velocity, density and the ion temperature of the plasma. In order to clarify the electrostatic polarization of the plasma in a shock wave, formulas developed for analyzing the pinch effect were applied. (TTT)

44158 TRANSPORT EQUATIONS FOR A WEAKLY IONIZED ELECTRON GAS. Walker, E. L.; Tanenbaum, B. Samuel (Case Western Reserve Univ., Cleveland). Phys. Fluids, 11: 1955-8 (Sept. 1968).

The Grad 13-moment method (using separate zero-order species flow velocities and temperatures) is used to calculate the electron traceless pressure P_e and heat flow q_e for a weakly ionized gas in a dc magnetic field. Electron–neutral collisions are assumed to dominate and the "transport approximation" is used to obtain expressions for P_e and q_e using arbitrary inverse power interparticle force laws. The results, under most conditions, show terms that are similar to the usual expressions for a simple gas except that the electron viscosity and thermal conductivity involve the electron–neutral collision frequency ν_{en} rather than the electron self-collision frequency. In addition, there are terms in q_e proportional to any differences in the zero-order electron and neutral flow velocities and temperatures. Finally, it is noted that the electron–neutral interparticle force law has very little effect on the form of the results (although it is important in determining the explicit value for ν_{en}). (auth)

44159 KINETIC THEORY OF HIGHLY NONEQUILIBRIUM PLASMAS. Yen, James T. (Grumman Aircraft Engineering Corp., Bethpage, N. Y.). Phys. Fluids, 11: 1958-67(Sept. 1968).

Nonequilibrium plasma states involving nonsmall current densities and/or enhanced electron temperatures are studied by taking 13 moments of the Boltzmann equation and using a new approach. New and nonlinear collisional terms are found for the basic equations. The electrical conductivity is calculated for the fully ionized case under no applied magnetic field: It first decreases slowly from the Spitzer–Härm value, then turns sharply around and finally increases as a cubic power in the current density. The sharp turnaround is located roughly at the electron sonic point. Regarding the supersonic states it is observed that they can be reached and maintained as steady states if the local electric field is properly reduced below the critical runaway field ϵ_c and is limited to the steady-state value. Some associated instabilities and ways of stabilization are discussed. It is also observed that unsteady "runaway" will occur when ϵ_c is exceeded, as emphasized by Dreicer. The possibility of an insurmountable "electron sonic barrier" is indicated. Experimental studies are urged. (auth)

44160 OBSERVATION OF FLUCTUATIONS IN THE PLASMA CONFINED IN THE TOROIDAL OCTOPOLE. Ohkawa, Tihiro; Yoshikawa, Masaji (Gulf General Atomic Inc., San Diego, Calif.). Phys. Fluids, 11: 2039-49(Sept. 1968).

Observations of the fluctuations by electrostatic and magnetic probes are made in the toroidal octopole device. The plasma density is varied from 5×10^8 cm^{-3} to 10^{10} cm^{-3}. The ion and electron temperatures are approximately 100 and 6 eV, respectively. The fluctuations exist only where the density gradient is large. The amplitude of the potential fluctuation is less than one-hundredth of the electron temperature at the strongest magnetic field. A transmission experiment is performed to obtain the dispersion relation of the waves. Qualitative comparison with linear theory on instabilities singles out the drift cyclotron instability as consistent with the observations. Quantitative comparison with the computed dispersion relation is also made on the dependence on the magnetic field and the plasma density. The rate of transport of the plasma across the magnetic field estimated from the fluctuation amplitudes is orders of magnitude smaller than the rate obtained from the ion confinement time. The amplitudes can be reduced when the magnetic field is increased or when a small toroidal field is applied. (auth)

44161 TWO-DIMENSIONAL MAGNETOHYDRODYNAMIC TURBULENCE. Robinson, D. C. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Phys. Fluids, 11: 2054-5(Sept. 1968).

For a system governed by a generalized Ohm's law, an arbitrary velocity field cannot independently maintain magnetic field fluctuations in a two-dimensional situation. (auth)

44162 NONLINEAR EFFECTS OF PROPAGATING EXTRAORDINARY WAVES IN A COLD PLASMA. Das, K. P. (Jalpaiguri Engineering Coll., West Bengal, India). Phys. Fluids, 11: 2055-7(Sept. 1968).

The perturbation method of Bogolyubov, Krylov, and Mitropolski is applied to the study of nonlinear effects of propagating waves of extraordinary mode in a cold plasma. Amplitude-dependent wavelength and frequency shifts including relativistic corrections are obtained. (auth)

44163 TWO-DIMENSIONAL THETA-PINCH DYNAMICS WITH TRANSVERSE MAGNETIC FIELDS. Duechs, Diethelm (Institut fuer Plasmaphysik, Garching, Ger.). Phys. Fluids, 11: 2010-18 (Sept. 1968).

The complete set of equations for the two-fluid model of a fully ionized plasma, the parameters of which depend on two spatial dimensions and time, is solved by a computer program. This program is applied to the problem of plasma rotation in a theta pinch caused by transverse multipole fields. The results show that the plasma does not rotate like a cylindrical rigid body, rather the velocity varies strongly with azimuth. Moreover, the rotation changes direction along the radius. Therefore, transfer of angular momentum from outside is not necessary for the existence of rotation. Even in small transverse fields ($B \sim 500$ G) the rise time for the angular velocity is of the order of 10^{-7} sec and very short compared with those obtained from previous theoretical models. (auth)

44164 BREMSSTRAHLUNG AND SCATTERING AT HARMONICS OF THE PLASMA FREQUENCY. Manheimer, Wallace M. (Massachusetts Inst. of Tech., Cambridge). Phys. Fluids, 11: 2019-22(Sept. 1968).

An expression is derived for the bremsstrahlung intensity at the $n + m$ harmonic of the plasma frequency ω_p and for incoherent scattering intensity at the incident frequency ν plus or minus $n\omega_p$. The bremsstrahlung intensity at $3\omega_p$ and incoherent scattering intensity at $\nu \pm 2\omega_p$ are explicitly calculated. The intensity is shown to be very small unless the plasma is highly turbulent. (auth)

44165 BREMSSTRAHLUNG OF A FULLY IONIZED PLASMA IN THE INFRARED. Bogen, P.; Rusbueldt, D. (Kernforschungsanlage, Juelich, Ger.). Phys. Fluids, 11: 2022-4(Sept. 1968).

The frequency dependence of the bremsstrahlung for $h\nu \ll kT$ and $\nu > 2\nu_p$ (where ν_p is the plasma frequency) has been measured and compared with theory. Experiments have been carried out on a theta pinch with the following data: $\frac{1}{4}\,\tau = 0.75$ μsec, $B_{max} =$ 45 kG, $T \approx 10^6$ °K, $N_e \approx 3 \times 10^{17}$ cm^{-3}. The intensity between 0.25 μ and 25 μ has been measured with a time resolution of 20 nsec, using an InAs photoiodide and a copper-doped germanium photoresistive detector in the infrared, and a photomultiplier in the visible and uv domains. It was verified that the emission signals observed side-on were at all times and for all wavelengths practically proportional to one another; shape differences observed end-on resulted almost certainly from refractive index effects. The experiments confirm the theoretical prediction, that the Gaunt factor should vary by a factor of 2 in the investigated wavelength domain. No influence of three-body encounters or nonthermal radiation has been detected. (auth)

44166 SYNCHROTRON RADIATION EXPERIMENTS WITH A HOT ELECTRON PLASMA. Sesnic, S.; Lichtenberg, A. J.; Trivelpiece, A. W.; Tuma, D. (Univ. of California, Berkeley). Phys. Fluids, 11: 2025-31(Sept. 1968).

The synchrotron radiation emitted parallel and perpendicular to the magnetic axis of a "hot electron" plasma ($T_e = 80$ keV) confined in a 50-kG magnetic mirror field has been measured in the 4 to 0.2-mm wavelength region of the electromagnetic spectrum by means of a spectrometer system capable of determining the absolute intensity of the synchrotron radiation. The experimental spectrum agrees with the theoretical spectrum based on single-particle emission and a two-dimensional Maxwellian distribution for the plasma electrons. The electron temperature and density predicted by the measured spectrum agree with other methods of measurement of these quantities. (auth)

44167 SINGLE-ENDED Q-DEVICE. Decker, John A. Jr. (Comstock and Wescott, Inc., Cambridge, Mass.). Phys. Fluids, 11: 2032-5(Sept. 1968).

The equilibrium theory of the Q device is extended to the "single-ended" configuration by use of an approximate model which only considers source and axial loss terms and ignores cold-end-plate phenomena. Numerical calculations which explicitly include alkali-metal adsorption effects at the ionizer surface are compared with single-ended Q-device operating data. The surprisingly good agreement between the predictions of this simplified model and the observations for axial magnetic fields above about 2 kG—with the exception of an unexplained anomaly at a cesium flux of 10^{17} cm$^{-2}\cdot$ sec^{-1}—indicates that the "single-ended" Q device is remarkably insensitive to cold-end and plasma-column conditions. (auth)

44168 ONE-DIMENSIONAL PLASMA MODEL IN THE PRESENCE OF A MAGNETIC FIELD. Hasegawa, Akira (Osaka Univ. Nagoya Univ., Japan); Okuda, Hideo. Phys. Fluids, 11: 1995-2003(Sept. 1968).

A new sheet model is developed which is suitable for studying one-dimensional electromagnetokinetic disturbances propagating with an arbitrary angle to an applied magnetic field. The model is a generalization of the sheet charge-type models previously considered. The concept of a retardationless electromagnetic field is introduced to provide the coupling between the sheet charges and currents. Some examples of wave propagation using the model are shown which compare very well with those predicted from the dispersion relation. (auth)

44169 TURBULENT DIFFUSION, PARTICLE ORBITS, AND FIELD FLUCTUATIONS IN A PLASMA IN A MAGNETIC FIELD. Weinstock, Jerome (Environmental Science Services Administration, Boulder, Colo.). Phys. Fluids, 11: 1977-81(Sept. 1968).

A universal relationship is deduced between diffusion coefficients, electric field spectra, and averaged Liouville orbit functions for a turbulent plasma in a magnetic field. This relation is a generalization of a similar relation previously derived by Dupree from completely different considerations. In particular, the solution of the Vlasov equation is avoided. Aside from generality and rigor, the present result differs from Dupree's in that the latter involves Vlasov orbit functions whereas the former involves Liouville orbit functions. The Liouville orbit function is easily evaluated by expanding in terms of the cumulants (semi-invariants) of the moments of the exact particle orbits. Dupree's results are thus produced without having to solve the nonlinear Vlasov equation. The present results can be viewed as an extension of Spitzer's diffusion formula to strong plasma turbulence. Conditions for the validity of the diffusion expression are determined, and corrections are made for mode frequencies in excess of gyrofrequencies. (auth)

44170 TEST-PARTICLE PROPAGATOR AND ITS APPLICATION TO THE DECAY OF PLASMA WAVE ECHOES. Hinton, F. L.; Oberman, C. (Princeton Univ., N. J.). Phys. Fluids, 11: 1982-9(Sept. 1968).

The conditional probability density $W(x,v,t|x_0,v_0,t_0)$ describing the motion of a test particle satisfies a kinetic-type equation, which was first systematically discussed by Rostoker for stable plasmas and was generalized by Rogister and Oberman to describe weakly turbulent plasmas. A systematic expansion for the solution of this equation is presented which is valid for short times on the kinetic time scale. However, these times are of sufficient length to describe the decay of plasma wave echoes due to collisions or weak turbulence. (auth)

44171 DYNAMIC BEHAVIOR OF IMPLODING MAGNETICALLY DRIVEN AXISYMMETRIC SLUG-TYPE PLASMA SHEETS. Guman, William J. (Rensselaer Polytechnic Inst., Troy, N. Y.). Phys. Fluids, 11: 1968-76(Sept. 1968).

The dynamic behavior of magnetically driven axisymmetric plasma sheets of negligible thickness is examined by postulating a simplified two-dimensional plasma sheet model. The equations of motion in the axial and radial directions are derived in Lagrangian form for the general case of time-varying current. For the case of constant current, the general solution of the equations of motion is obtained. These equations of motion are solved for three different types of small sinusoidal perturbations of a cylindrical implosion. The plasma sheet configurations, particle trajectories, and surface mass density variations are presented for representative examples. (auth)

44172 THERMAL LOSSES IN A PULSED PLASMA ACCELERATOR. Rushailo, A. M. Zh. Prikl. Mekh. Tekh. Fiz., No. 1, 117-20(1968). (In Russian).

It is shown that the uneven distribution is due primarily to the large thermal losses in the channel. By reducing the unevenness of the discharge distribution it was possible to reduce experimentally the loss in the accelerating electrodes and increase the energy efficiency of the accelerator from 45 to 60%. The tests were made under single-discharge conditions and the working medium was material produced by erosion of electrodes (copper or Duralumin) or insulators (quartz or teflon). The measurements consisted of determining the initial energy of the discharge-producing capacitors and the initial pressure in the working chamber, the energy fed to the accelerating electrodes, the distribution of the heat fluxes over the surface of the outer electrode, the distribution of the brightness of the discharge, and the energy efficiency. The procedure and the data reduction method are described. The main factor in reducing the heat loss and increasing the efficiency was the change in the shape of the channel, from that with a narrow bottleneck to a quasi-cylindrical one. (ATD)

44173 NONLINEAR INTERACTIONS OF CYCLOTRON HARMONIC PLASMA WAVES. Ellis, R. A. Jr.; Porkolab, M. (Princeton Univ., N. J.). Phys. Rev. Lett., 21: 529-33(Aug. 19, 1968).

Experimental and theoretical evidence of resonant and nonresonant mode coupling of cyclotron harmonic plasma waves is presented. (auth)

44174 PARAMETRIC EXCITATION FROM THERMAL FLUCTUATION AT PLASMA-DRIFT WAVE FREQUENCIES. Yong, Alfred Y.; Goldman, Martin V.; Hai, Francis; Rowberg, Richard (Univ. of California, Los Angeles). Phys. Rev. Lett., 21: 518-22 (Aug. 19, 1968).

Experimental verification is presented of the parametric enhancement of thermal fluctuations, the power balance, and the parametric threshold. (auth)

44175 INFLUENCE OF HOLLOW CATHODE WITH MAGNETIC FIELD ON IONIZATION WAVES IN A NEON DISCHARGE PLASMA. Popovici, C. (Inst. of Atomic Physics, Bucharest); Krejci, V.; Stirand, O. Rev. Roum. Phys., 13: 423-6(1968).

The influence of an external magnetic field applied parallel to the electric field of the cathode fall domain, on the ionization waves in a glow discharge with hollow cathodes in neon gas was investigated. The results obtained have shown the occurrence of three domains in the pressure–current intensity diagram, the limit between the domain in which oscillations are not present and the neighboring ones in which ionization waves are produced, depending on the given value of the magnetic field. (auth)

44176 STUDIES OF CATHODE DISCHARGE DEPENDENCE ON GAS FLOW AND IN ARC OPERATION. Delcroix, J. L.; Minoo, H.; Trindade, A. R. (Faculte des Sciences, Orsay, France). Rev. Roum. Phys., 13: 401-22(1968). (In French).

Hollow cathode arc discharges are studied with the argon gas and a tantalum cathode. The main experimental results concern: the discharge V–I characteristics and their dependence in the magnetic field strength B and the gas flow rate Q; the establishment of the discharge energy balance with the measurements of the power dissipation on the cathode (W_C), the anode (W_A), and the external positive column (W_P); the electric field X_E and the electron temperature T_e in the external positive column; the electric field X_I in the positive column inside the cathode cavity; the various operating modes of the anode and the cathode; multichannel cathodes, etc. The two following general rules concerning the internal positive column are established: (1) the neutral gas pressure P_l at the active zone level (the point where the cathode temperature is maximum) is constant and independent of the flow rate Q and the cathode cavity diameter d; and (2) for a given flow rate the product $B_c \cdot d$ is constant and independent of the d (B_c being an "internal confinement field" for which the discharge characteristics V–I go through an important change). Typical conditions of operation are: $(W_C/W_T) = 15$ to 25%, $(W_A/W_T) = 65\%$, (W_P/W_T) 10 to 20% (W_T is the discharge total power); $X_E = 0.2$ V/cm; $X_I = 8$ V/cm; $T_e = 4$ eV; $V_C = 12$ V; $V_A = 17$ to 21 V (in some conditions: $V'_A = 40$ to 50 V); $P_l = 4$ Torrs (for an Argon flow through a tantalum cathode) $B_c \cdot d = 20$ G cm (for $Q = 0.3$ cm^3/s – STP) and = 10 (for $Q = 0.14$). (auth)

44177 THEORY OF NONLINEAR INTERACTION OF A MODULATED BEAM WITH PLASMA. Krasovitskii, V. B.; Kurilko, V. I.; Strzhemechnyi, M. A. At. Energ. (USSR), 24: 545-9(June 1968). (In Russian).

A nonlinear problem of the stability of a density-modulated beam in plasma is investigated. The reversal effect of exciting oscillations on the motion of beam particles is the main factor of the nonlinear problem. A case of strong modulation is analyzed when dimensions of ion and electron bunches are small as compared to the modulation period $L = \lambda$; the bunches are modulated with charged discs. A nonlinear equation is derived which describes the trajectories of a bunch and the behavior of the generated fields. Expressions for maximum amplitudes of the electric field are obtained; the physical picture of the generation and stabilization of oscillations is discussed. (auth)

44178 PSEUDOPOTENTIAL FOR QUASI-CLASSICAL PLASMA. Yukhnovskii, I. R.; Khettskheim, Kh. (Lvov State Univ.). Ukr. Fiz. Zh., 13: 881-9(June 1968). (In Russian).

An expression for the pseudopotential of a high-temperature plasma ($\varkappa\lambda < 1$) as well as expressions for a screened potential, free energy, and binary function is obtained on the basis of the method of displacements and collective variables. The properties of the pseudopotential are investigated in the range of small and great distances. The calculations are carried out in the space (r,p) without taking into account exchange effects. (auth)

44179 SITES OF LANDAU POLES. Ahier, Georges (CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. A and B, 266: 1495-8(June 17, 1968). (In French).

In the complex semi-plane of ω, the Landau poles are infinite in number and situated in a family of characteristic curves or modes. For every value given by the relation $\nu = \lambda/\lambda_p$ (λ_p, the Debye length may be ν_{th}/ω_p) there exists one pole and only one in each mode. The curves, loci of poles of the same ν, tend asymptotically and in only one direction toward the bisectors of the axes. The modes and latter curves are drawn using the tables of Karpov, and compared with the less-elaborate results of others. (tr-auth)

44180 STUDY OF THE SHEATH SURROUNDING THE NEUTRALIZER IN A SYNTHESIZED PLASMA. Spiess, Gerard (CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. A and B, 266: 1499-1501(June 17, 1968). (In French).

From the Poisson equation and using a hydrodynamic model it is shown that the injection of neutralizing electrons in a beam of ions of several keV is assured by a sheath where the voltage drop is about 1 V, the main part of which is near the diameter of the emitting filament. This sheath plays a role in regulating the injected electron intensity. (tr-auth)

44181 INSTABILITY NEAR ELECTRON CYCLOTRON HARMONICS IN BEAM–PLASMA SYSTEM. Idehara, Toshitaka (Kyoto Univ.). Mem. Fac. Sci., Kyoto Univ., Ser. Phys., Astrophys., Geophys., Chem., 32: No. 2, 13-27(Mar. 1968).

Instabilities near harmonics of the electron cyclotron frequency are observed when a weak electron beam is injected into a plasma in nearly thermal equilibrium. Measurements of microwave emission show that the electron cyclotron harmonics are enhanced strongly by the electron beam passing through the plasma, and, that at the same time, the second harmonics of the enhanced cyclotron harmonics are generated by a nonlinear effect in plasmas. The experimental results are interpreted by means of the model of a Maxwellian plasma penetrated by a monoenergetic electron beam. (auth)

44182 NONLINEAR PLASMA OSCILLATIONS NEAR ELECTRON CYCLOTRON HARMONICS. Terumichi, Yasushi (Kyoto Univ.). Mem. Fac. Sci., Kyoto Univ., Ser. Phys., Astrophys., Geophys., Chem., 32: No. 2, 1-11(Mar. 1968).

The second-harmonic emission from plasma is studied when the plasma is irradiated by an exciting microwave signal. Three kinds of resonant structures near electron cyclotron harmonics were observed and concluded to result from inherent nonlinear properties of the plasma. A series of resonant peaks is observed at magnetic fields higher than those of the cyclotron harmonics for the exciting microwave signal and is interpreted as the second harmonics of the radial standing plasma waves confined to a region near the axis of the plasma column in the magnetic field. The other two kinds of resonant structures are observed at magnetic fields lower than those of the cyclotron harmonics. One possible explanation of the origin of these structures is proposed. (auth)

44183 THERMODYNAMIC CALCULATIONS FOR HIGH-TEMPERATURE AIR–CARBON DIOXIDE MIXTURES INVOLVING BLACK-BODY RADIATION. **Kuthe, R.; Neumann, Kl.-K. (Technische Hochschule, Brunswick). Z. Flugwiss., 13: 411-25(1965). (In German).**

The equilibrium composition and thermodynamic properties are provided in the form of diagrams as functions of pressure and temperature for thermal plasmas generated from air and carbon (nitrogen/oxygen ratio 79 : 21, carbon contents between 0 and 75%). The experiments were limited to the temperature–pressure region where the plasma consists of neutral atoms, atomic ions, and free electrons. The calculation is based on atomic constants (reaction energies, excitation energies, etc.). Complete thermodynamic equilibrium is assumed, including black-body radiation. With one exception, the assumption of ideal behavior was used; the order of magnitude of errors involved is discussed. Data are given for a range of temperatures from 10,000°K to 100,000°K at pressures of 100, 10, and 1 bar, in the region of temperatures from about 6000°K to close to the temperature where the radiation pressure becomes equal to the total pressure (at pressures of 0.1, 0.01, and 0.001 bar). The following parameters are given in form of diagrams: equilibrium compositions, total enthalpy and individual enthalpies (enthalpy of translation, enthalpy of radiation, etc.), the ratio of the effective sp ht, electron densities, and enthalpy–entropy diagrams for air with 1% C, 10% C, 25% C, 50% C, and 75% C. The results are compared with those for pure air. (BBB)

44184 INTERFEROMETRIC MEASUREMENTS OF ARGON AND NEON PLASMAS IN THE 8-MM BAND. Bottreau, Andre; Marzat, Claude (CNRS, Gironde, France). Compt. Rend., Ser. A and B, 266: 1419-21(June 5, 1968). (In French).

Experimental results are given of measurements using interferometry of microwaves of the phase and amplitude of the transmission coefficient of a plasma having the particular configuration described previously. The gases studied are argon and neon. Measurements are made as a function of the discharge current I, of the pressure p, and of the confining field B. (tr-auth)

Production of Plasma

44185 (IPP-1/79) A MODEL FOR THE IONIZATION OF A HYDROGEN GAS BY OHMICLY HEATED ELECTRONS. Koeppendoerfer, W. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Mar. 1968. 30p. Dep.

For the purpose of supporting the experimental work in ionizing a hydrogen or deuterium gas by high-current discharges, a simple model is presented which describes the ionization by ohmicly heated electrons. Simple scaling laws are introduced by normalizing the equations with respect to the filling density. This is possible if the considerations are restricted to a density region where binary collisions prevail and if homogeneity of the plasma is assumed. The results provide values for the minimum current density necessary to ionize the gas in a certain time and for a given filling density. (auth)

44186 SIMILARITY CRITERION OF ELECTRIC DISCHARGES IN GASES. Dautov, G. Yu. Zh. Prikl. Mekh. Tekh. Fiz., No. 1, 137-9(Jan.-Feb. 1968). (In Russian).

Paschen's law of electric breakdown which involves application of the theory of similarity and scaling to discharge phenomena in stationary gases, was applied to explain findings in electric arc experiments. The case considered relates to a gas stream in a channel, in which an electric discharge takes place in the axial direction. The equation derived reflects the physical processes in electric discharges which determine the current density, the field tension, and thereby the generated Joule heat. The stream of neutral particles is responsible not only for the mass but also for the heat transfer of the system. The similarity criterion expresses the overall energy balance of the arc. It was found that if there is a flow of gas and arc discharge in the channel, in contrast to Paschen's law, the breakdown potential depends not only on the product of pressure and velocity but also on the I/G and I/d ratios, whereby I designates the discharge current and d is the diameter of the channel. (TTT)

44187 EXPERIMENTAL STUDY OF A PLASMA-GENERATOR. Fauchais, P. (Faculte des Sciences, Poitiers, France). Rev. Int. Hautes Temp. Refract., 5: 71-87(Apr.-June 1968). (In French).

A classical technology (anodic nozzle made of red copper and cathode made of thoriated tungsten, coaxial with the nozzle) was used to build a generator having interchangeable nozzles and cathodes, which provides stable argon, helium, hydrogen, and nitrogen plasmas for gas rates of 3 to 150 l/min and power of 4 to 70 kW. This generator has been equipped with a measuring device making possible the determination of the output ρ and of the energy Q_G transferred to the gas with an accuracy of ±3p. 100. Its study showed that its working parameters depend, not only on the kind and flow of the gas, on the current intensity dissipated into the arc, and on the electrical parameters of the circuit, but also on the size of the nozzle, on the arc chamber (made of zirconia), and on the symmetry of gaseous flow along the cathode. (auth)

Stability of Plasma

44188 (MATT-619) FINITE ION LARMOR RADIUS AND ION–ION COLLISION EFFECTS ON EQUILIBRIUM, CRITICAL FLUCTUATION, AND DRIFT-WAVE STATES OF ALKALI-METAL PLASMA. Chu, T. K.; Hendel, H. W.; Motley, R. W.; Perkins, F.; Politzer, P. A.; Stix, T. H.; von Goeler, S. (Princeton Univ., N. J. Plasma Physics Lab.). July 1968. Contract AT(30-1)-1238. 21p. (CONF-680805-14). Dep. CFSTI.

From 3rd International Conference on Controlled and Plasma Physics, Novosibirsk, USSR.

Recent experiments and theories show that the effects of finite Larmor radius and ion–ion collisions, i.e., ion transverse viscosity, play a major role in determining the equilibrium state, and the linear stabilization and nonlinear amplitude saturation of the collisional drift-wave state in alkali-metal plasmas. (auth)

44189 (MATT-623) SOME INVESTIGATIONS OF NONLINEAR PLASMA BEHAVIOR ON ONE-DIMENSIONAL PLASMA MODELS. Dawson, J. M.; Hsi, C. G.; Shanny, R. (Princeton Univ., N. J. Plasma Physics Lab.). July 1968. Contract AT(30-1)-1238. 24p. (CONF-680805-15). Dep. CFSTI.

From 3rd International Conference on Controlled and Plasma Physics, Novosibirsk, USSR.

Earlier calculations on the two-stream instability using the sheet model are extended. Vortexes in phase space similar to those found by Roberts and Berk are found. A new finite-size particle model is developed to reduce collisional effects. This model suppresses the short-wavelength field fluctuations while leaving the long-wavelength collective modes unaffected. The turbulence generated by a small bump in the tail of the distribution function is investigated on this model. It is found here, as in the sheet model calculations, that a hot Maxwellian tail is formed which coexists with the main plasma for a very long time. (auth)

44190 (NP-17559) PLASMA INSTABILITY IN A NONHOMOGENEOUS ULTRAHIGH-FREQUENCY FIELD. Preprint No. 7. Batanov, G. M.; Sarksyan, K. A.; Silin, V. A. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). 1968. 31p. (In Russian). Dep.

Studies were made of a plasma jet moving along a homogeneous magnetic field, crossing a circular waveguide, and colliding in the waveguide with an excited, traveling-wave ultrahigh-frequency field. It is shown that inclusion of the TE_{11} wave in the plasma-generated electron beam and induced turbulence in the charged-particle density along the plasma jet cross section resulted in plasma losses on chamber walls all along the length of the flow. In the case in which the wave became excited before the plasma front arrived, the plasma remained stable. The mechanism of plasma instability was analyzed. (tr-auth)

44191 (NP-17573) THE THEORY OF EQUILIBRIUM AND STABILITY OF STRONG CURRENT DISCHARGE IN A DENSE OPTICALLY TRANSPARENT PLASMA. II. Preprint No. 11. Rozanov, V. B.; Rukhadze, A. A.; Triger, S. A. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). 1968. 18p. (In Russian). Dep.

Equilibrium and stability of a strong-point discharge in a dense optically transparent plasma are studied. It is shown that, in contrast to the optically nontransparent plasma, the temperature of a transparent discharge changes on the same scale as other hydrodynamic magnitudes. Small-oscillation spectral analysis revealed that, within the limits of geometrical optics approximation, the discharge was unstable. Discharge stability was studied considering mainly bremsstrahlung. However, some data were obtained on the instability produced by other types of radiation. (tr-auth)

44192 INSTABILITY OF A WEAKLY IONIZED PLASMA LAYER IN CROSSED ELECTRIC AND MAGNETIC FIELDS. Kim, K. I. Zh. Prikl. Mekh. Tekh. Fiz., No. 1, 35-40(Jan.-Feb. 1968). (In Russian).

As a result of collisions with neutral atoms, charged particles in a weakly ionized plasma exhibit varying drift velocities, resulting in the creation of instabilities. This type of instabilities has been examined by A. Simon, who developed a theory concerning the behavior of plasma in crossed electric and magnetic fields. The problem was further studied, considering inhomogeneous plasma currents with alternating conducting and nonconducting layers. The instability of the weakly ionized plasma was thus studied under condition of crossed fields, with a concentration inhomogeneity in a perpendicular direction with respect to the external field. Equations were derived for reflecting the effect of ionization changes in the diffusion currents caused by the perturbed concentration gradient and the electric field. In contrast to the effect of ionization, the change of currents exerts a stabilizing effect on the original state of the plasma layer. (TTT)

44193 STABILITY OF A SYNTHESIS PLASMA. Spiess, Gerard; Bonnal, Jean-Francois; Manus, Claude (CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. A and B, 266: 1212-14(Apr. 29, 1968). (In French).

The longitudinal stability of a synthesis plasma was studied by introducing in the dispersion equation of plane waves the particular form of the distribution functions of the velocities of the beam ions and the neutralization electrons. It is shown that the plasma is stable for all wave lengths when the mean velocity of the ions is low with respect to the thermal velocity of the electrons. (tr-auth)

44194 BEHAVIOR OF THE PLASMA FURNISHED BY A MIXED FIELD ACCELERATOR IN THE PRESENCE OF CONTINUOUS OR PULSED MAGNETIC MIRRORS. Brunet, Andre; Geller, Richard; Jacquot, Bernard (CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. A and B, 266: 1209-11 (Apr. 29, 1968). (In French).

The experimental results obtained with equipment of the Pleiade type when the accelerated plasma jet encounters either a continuous magnetic mirror or a pulsed magnetic mirror for 70 μsec are reported. In the first case, it is shown that instabilities destroy the ionic acceleration, whereas, in the second case, an accumulation of energetic particles can be obtained, limited essentially by the charge exchange of the ions. (tr-auth)

44195 UNSTABLE, TRANSVERSE-DISPLACEMENT MODE OF A BUMPY PLASMA COLUMN AND ITS POSSIBLE STABILIZATION. Ribe, F. L.; Riesenfeld, W. R. (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids, 11: 2035-8(Sept. 1968).

Extension of considerations of high-β toroidal equilibria allows calculation of the destabilizing $m = 1$ force on a straight axisymmetric, bumpy plasma column. The modification of the bumpy equilibrium by a weak longitudinal current is determined. The $m = 1$ mode becomes helical and can be stabilized when the current is oscillated. (auth)

44196 VISUALIZATION OF PLASMA FLUTES IN A Q-MACHINE. Cataldo, Joseph C.; Jen, Norman C. (City Coll., New York). Phys. Fluids, 11: 2057-8(Sept. 1968).

The plasma camera has been used to observe flute modes in a single-ended Q machine. The flutes, rotating in the E × B direction, are irregular extensions of the plasma column and exhibit a convective mass transfer phenomenon by the breaking off of the flutes. (auth)

44197 FLUTE INSTABILITY OF A HIGH DENSITY PLASMA IN THE PRESENCE OF ELECTRIC FIELD. Davydova, T. A.; Dnestrovskii, Yu. N. (Kiev Inst. of Physics). Ukr. Fiz. Zh., 13: 1019-27(June 1968). (In Russian).

The stability of flute oscillations is considered in a cylinder of a relatively high-density plasma ($\omega_{0i}^2 \gtrsim \omega_i^2$ where ω_{0i} and ω_i are the ion plasma and cyclotron frequencies) in the presence of the nonuniform electric field $E_0(r)$. The differential equation of A. Simon and M. N. Rosenbluth is used for description of flute oscillations. By means of qualitative and quantitative solutions of the problem, some properties of the spectrum are studied and the growth rates of unstable oscillations are evaluated. In the case of high or moderate plasma density ($\omega_{0i}^2 \gtrsim \omega_i^2$), in contrast to the low-density limit ($\omega_{0i}^2 \ll \omega_i^2$), a small excess of electrons (when $E_0 < 0$) gives rise to stabilization of the plasma oscillations. (auth)

44198 SCATTERING OF ELECTROMAGNETIC WAVES ON TURBULENT PLASMA PULSATIONS. Kalinin, Yu. G.; Lin, D. N.; Ryutov, V. D.; Skoryupin, V. A. Zh. Eksp. Teor. Fiz., 55: 115-21(July 1968). (In Russian).

Combinational scattering of external electromagnetic waves on turbulent oscillations of a plasma is investigated. The self-radiation spectrum of the plasma in the centimeter wavelength range is obtained. The energy density of Langmuir and ion-acoustic oscillations are estimated. It is shown that under the conditions of the given experiment the characteristic wave vector of the scattering oscillations by order of magnitude equals the Debye wave vector. The degree of turbulence of the plasma is determined and found to be 0.02. (auth)

Thermonuclear Processes

44199 (NYO-3863-8) [THERMONUCLEAR RESEARCH]. Quarterly Progress Report, March 26–June 25, 1968. (Avco-Everett Research Lab., Everett, Mass.). July 1968. Contract AT(30-1)-3863. 12p. Dep. CFSTI.

HIGH-ENERGY INJECTION DEVICES—experiments in Mark I and II toroidal
ELECTRONS—confinement in toroidal apparatus, (E/T)
THERMONUCLEAR REACTIONS—research on (D.L.C.)

Shielding

Refer also to abstracts 44744 and 44753.

44200 (RRA-M-74) A COMPARISON OF MONTE CARLO CALCULATED AND EXPERIMENTALLY DETERMINED ENERGY AND ANGLE SPECTRA FOR ^{137}Cs. Marshall, J. D.; Wells, M. B. (Radiation Research Associates, Inc., Fort Worth, Tex.). June 11, 1967. Subcontract 2329. 18p. (CONF-670602-31). Dep. CFSTI.

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif.

For Oak Ridge National Lab., Tenn.

Experimental data, which give the spatial, energy, and angle distributions of gamma rays in water and an air-like medium for a ^{137}Cs source, were presented by Alberg, et al., at the 1966 Winter Meeting of the Americal Nuclear Society. At the same meeting, Marshall and Wells presented the results of extensive Monte Carlo calculations of the spatial, energy, and angle distribution of the gamma-ray flux in air for point isotropic sources. Since the source energies considered in the Monte Carlo calculations did not include the energy of the gamma rays emitted by ^{137}Cs, it was decided to run a Monte Carlo problem for that energy so that a direct comparison could be made with the measured data. The measured spectra for water, which were experimentally reproducible to within 10% except for large angles, were presented by Alberg in graphs giving $4\pi r^2$ times the differential energy flux at r multiplied by exp ($\mu_0 r$). This method of presentation facilitated conparison of spectra taken at different radial distances and also allows for comparison with data for other media. The Monte Carlo calculations of the spatial, energy, and angle distributions of the energy flux for a point isotropic 0.662-MeV gamma-ray source in an infinite air medium, as well as the spatial distribution of the total energy spectra, agreed reasonably well with the measured data. This agreement gives mutual validation of both the experiment and the calculation. Furthermore, it lends support for the use of infinite-medium water data for calculation of gamma-ray penetration in an infinite-air medium. (auth)

44201 DETERMINATION OF THE DIFFUSION PARAMETERS FOR THERMAL NEUTRONS IN WATER USING THE PULSED METHOD AND SPHERICAL GEOMETRIES. Elkert, Jan (Chalmers Univ. of Tech., Gothenburg, Sweden). Nukleonik, 11: 159-62(1968).

By means of the pulsed neutron source method and using spherical geometries the diffusion parameters for thermal neutrons in water have been determined at the temperature 21.7°C. The following values were obtained with the buckling dependence of the extrapolation distance according to the calculations by Schmidt and Gelbard: $v_0\Sigma_{a0} = 4830 \pm 65$ sec^{-1}, $D_0 = 36{,}690 \pm 390$ cm^2 sec^{-1} and $C = 4280 \pm 410$ cm^4 sec^{-1}. It was found that different buckling dependences of the extrapolation distance and different weight factors in the least-squares fit appreciably affect the parameters, especially the diffusion cooling coefficient C, and make a comparison with the values of C obtained in earlier experiments somewhat difficult. The microscopic absorption cross section of hydrogen, obtained from the value of $v_0\Sigma_{a0}$, is 0.328 ± 0.004 barn. (auth)

44202 GAMMA-RAY SHIELDING STUDIES WITH MONOENERGETIC GAMMA RAYS FROM POSITRON ANNIHILATION. Lonergan, J. A.; Herring, D. F. (Gulf General Atomic Inc., San Diego, Calif.). Nucl. Appl., 5: 79-84(Aug. 1968).

A positron beam is produced and accelerated by an electron linear accelerator. The positrons annihilate in-flight when passed through a beryllium foil to produce nearly monoenergetic gamma rays with energies comparable with the positron energy and an energy spread essentially equal to the energy spread of the positron beam, i.e., 2%. Such a 10-MeV gamma-ray beam was collimated and directed at a slab of aluminum that had a thickness corresponding to one mean free path for 10-MeV gamma rays. The energy spectra at 0, 15, and 30° to the incident beam were measured with a NaI crystal. The results were integrated and compared with Monte Carlo calculations. The experiments and calculations agreed within the experimental uncertainty. (auth)

44203 TEMPERATURE STRESS AND NUCLEAR RADIATION EFFECTS ON ELECTROMAGNETIC SHIELDING. Plantz, Vellar

C.; Schulz, Richard B.; Goldman, Reuben (Boeing Co., Renton, Wash.). IEEE (Inst. Elec. Electron. Eng.) Trans. Electro-magnet. Compatibility, EMC-10: 129(Mar. 1968).

The possible effects of known adverse environments upon the electromagnetic shielding effectiveness of electronic equipment enclosures are relatively unknown. Prior to conducting this study, opinions were solicited as to whether physical environments would affect the electromagnetic shielding characteristics of metal equipment enclosures. The consensus was that there would be no effect on electrical characteristics of the enclosures, provided that no physical damage occurred to the enclosures. No reports appeared to be available on the effects of environmental extremes upon the electromagnetic shielding effectiveness of electronic equipment enclosures. The effects of repeated temperature shock and of exposure to nuclear radiation on the shielding effectiveness of enclosures fabricated from several common metals, incorporating several types of seam construction, are being explored. (BBB)

44204 X-RAY RADIATION IN ELECTRON BEAM WELDING INSTALLATIONS. Kirichinskii, B. R.; Mirutenko, V. I.; Nazarenko, O. K. Avtomat. Svarka, No. 8, 22-5(Aug. 1967). (In Russian).

The intensity of x-ray radiation appearing in electron beam welding installations, based on the thickness of the protective screens necessary to reduce the dose of radiation at the working sites to the permissible limits, was measured. Radiation measurements were made using condenser ionization chambers with air-equivalent walls. The chambers were placed directly at the sight hole which was covered with a layer of plexiglass, absorbing the mild component of radiation. The accelerating voltage was 30 keV, current density 50 milliamp, and the material of the piece being joined was Mo. The necessary thicknesses of Pb screens, at voltages from 20 to 100 keV to obtain adequate shielding were calculated. Equivalent thicknesses of Fe at 60 and 100 keV were also determined. (Rev. Metal. Lit.)

Solid-State Physics

Refer also to abstracts 43081, 43163, 43194, 43583, 43584, 43608, 43619, and 44062.

44205 (AERE-R-5704) PROBLEM OF OBTAINING A UNIFORM VOLUME CONCENTRATION OF IMPLANTED IONS. Worth, J. H. (Atomic Energy Research Establishment, Harwell (England)). Mar. 1968. 37p. Dep. CFSTI. UK.

The problems involved in obtaining a uniform concentration of ions during ion bombardment of materials are discussed. Methods of achieving uniformity are described and their relative merits discussed. A computer program to calculate the ranges of any ions in any material is described and a FORTRAN listing given in an appendix. (auth)

44206 (CONF-680902-3) F CENTER FORMATION AT 78°K IN KBr AND IN RbBr DURING EXPOSURE TO MONOCHROMATIC X-RAY ENERGIES AROUND THE BROMINE K EDGE. Cruz, Baltasar A.; Gomberg, Henry J.; Diaz, Fernando (Puerto Rico Nuclear Center, Mayaguez. Puerto Rico Univ., Mayaguez). [nd]. Contract AT(40-1)-1833. 3p. Dep. CFSTI.

For presentation at International Symposium on Color Centers in Alkali Halides, Rome, Italy.

The rate of formation of F centers per unit energy retained in the crystal at 78°K was found to be the same for incident photon energies below and above the K edge in Br (13.5 keV). The energy expenditure per F center formed was 1.21×10^3 eV ± 4.4% for Harshaw KBr, and 2.36×10^3 eV ± 4.5% for freshly cleaved pure RbBr. The results indicate that K-shell ionization in Br does not affect the mechanism of formation of F centers in alkali metal bromides. (D.L.C.)

44207 (COO-1629-8) EVIDENCE OF COLLOIDS IN THE BELOW 1°K THERMAL CONDUCTIVITY OF γ-IRRADIATED KCl. Guenther, R. A.; Weinstock, H. (Illinois Inst. of Tech., Chicago. Dept. of Physics). Aug. 1968. Contract AT(11-1)-1629. 4p. Dep. CFSTI. (CONF-680808-5).

From Conference on Low Temperature Physics, St. Andrews, Scotland.

Measurements of the thermal conductivity of γ-irradiated KCl at 0.4 to 4°K were used to test a model of the radioinduced defects, in which aggregates of interstitial chlorine (colloids) are formed by irradiation. An equation for the temperature dependence of thermal conductivity is presented in terms of point defects and larger scatterers. Results for room-temperature γ irradiations are found to agree with curves calculated using a colloidal scatterer radius of 70 Å; scattering by point defects varies with the F-center concentration, and the colloid number is proportional to the total dose. Differences from crystal purity are found to be due to differences which existed in the crystals before irradiation. Results are also presented for 77°K irradiations with and without warmup before the measurements; they indicate that 77°K irradiations produce scatterers of large size which are annealed at 296°K. (D.L.C.)

44208 (GA-8758) LATTICE DYNAMICS AND NEUTRON SCATTERING OF BeO. Borgonovi, G. (Gulf General Atomic, Inc., San Diego, Calif.). July 3, 1968. Contract AT(04-3)-167. 33p. Dep. CFSTI.

For the calculation of neutron scattering by BeO, knowledge of its atomic motions is required. Since the work of Young and Koppel in 1966, elastic, preliminary neutron scattering, and Raman data become available and are used in the present calculations which use Born–von Karman vibrational dynamics. Inelastic and elastic scattering cross sections of BeO are calculated, and the total cross section is in good agreement with experimental data. (D.L.C.)

44209 (INP-598/PS) NIEKTORE METODY I WYNIKI BADAN FAL SPINOWYCH. (Some Methods and Results of the Investigation of Spin Waves). Wanic, Adam (Institute of Nuclear Physics, Krakow (Poland)). 1968. 32p. (In Polish). Dep.

The neutron, spectroscopic, and microwave methods of the investigation of spin waves are described. The results of the neutron measurements of the magnon dispersion relations in a number of magnetics are reviewed. (auth)

44210 (IS-T-220) HIGH FIELD MAGNETIZATION OF THULIUM SINGLE CRYSTALS. Richards, Durkee Benham (Ames Lab., Iowa). May 1968. Contract W-7405-eng-82. 73p. Dep. CFSTI.

Thesis.

A magnetometer was designed and constructed to be used in a 1.01-inch-bore superconducting solenoid wound with Nb_3Sn ribbon. It is of the vibrating-sample type and uses a null method in which the signal from the sample pickup coils is nulled out with a reference signal generated by a transducer on the sample rod. A bridge circuit is used to allow nulling the in-phase and quadrature components separately. With this magnetometer, the magnetization of thulium was measured along the $\langle 10\bar{1}0 \rangle$ and c-axis directions from 4.2 to 300°K and in magnetic fields up to 100 kOe. Low-field isofields for both directions indicate a Néel temperature of 58°K. The isotherms for both directions below 58°K show a large anisotropy favoring the c axis, and suggest that the antiferromagnetic structure below 58°K is an axial structure oriented along the c axis. The low-field isofield for the c axis shows that at about 42°K the antiferromagnetic structure begins to square up, and at about 25°K has become a ferrimagnetic structure with a net moment along the c axis at 4.2°K of 1.0 μ_B per atom. The ferrimagnetic coupling can be overcome by magnetic fields above 28 kOe yielding a ferromagnetic structure with a saturation magnetization of 7.14 μ_B per atom at 4.2°K. The $\langle 10\bar{1}0 \rangle$ direction, however, remained magnetically hard to the highest fields used; at 4.2°K the moment reached 0.75 μ_B per atom at 93 kOe. From plots of $1/x_g$ vs T, the value for μ_{eff} was found to be 7.61 μ_B. Extrapolating these plots to the temperature axis gave values for the paramagnetic Curie temperatures of $\theta_{||} =$ 41°K and $\theta_{\perp} = -17$°K, where $\theta_{||}$ is for fields applied along the c axis, and $\theta_{\perp}$ is for fields applied perpendicular to the c axis. The difference between these values is interpreted in terms of the large axial anisotropy of thulium. (auth)

44211 (JINR-P4-3706) TEORIYA ODNOMERNOI RESHETKI V PSEVDOGARMONICHESKOM PRIBLIZHENII. (The Theory of One-Dimensional Lattice in Pseudoharmonic Approximation). Plakida, N. M.; Siklos, T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 26p. (In Russian). Dep.

The properties of a linear chain are considered in the pseudoharmonic approximation at fixed length or fixed external tension. It is shown that the chain is unstable in the second case at sufficiently high temperature or sufficiently high zero-point energy. An internal energy, heat capacity, and coefficient of thermal expansion are calculated. (auth)

44212 (NP-17564) SPUTTERING AND ELECTRON EMISSION EXPERIMENTS WITH AN ELECTROMAGNETIC ISOTOPE SEPARATOR. Drentje, Sietze Anne (Groningen Rijksuniversiteit (Netherlands)). 1968. 114p. Dep.

Thesis.

The Groningen electromagnetic isotope separator and ion source are described, and a survey of the work with this separator is given. In the experiments, oriented Au foils, bombarded by 50-keV noble-gas ions, show sputtering maxima in the ⟨110⟩ directions. Sputtering from a (100) Cu face by 30–80 keV argon ions at various incident angles shows minima in the "open" directions of the crystal. Similarly, the electron emission of a bombarded (100) Cu face shows minima in the open directions. The theoretical interpretation of the results is considered, and a shadow model for sputtering and electron emission is developed. Focused collision sequences ("focusons") are considered. (D.L.C.)

44213 (ORNL-TM-2264) RADIATION-INDUCED PARAMAGNETIC STATES OF SOME INTRINSIC DEFECTS IN ALKALI-GERMANATE GLASSES, POLYCRYSTALLINE GeO_2, AND SINGLE CRYSTALS OF GeO_2, TiO_2, AND SnO_2. Purcell, Terry L. (Oak Ridge National Lab., Tenn.). Aug. 1968. Contract W-7405-eng-26. 119p. Dep. CFSTI.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

Radiation-induced paramagnetic states of some intrinsic defects in pure GeO_2 glasses, in GeO_2 glasses with added alkali metal oxide (M_2O/GeO_2 of 0.003, 0.03, and 0.3), and in crystals of GeO_2, TiO_2, and SnO_2 have been investigated by electron spin resonance (ESR) techniques. The ESR measurements were made at 10 GHz and at 300, 77, or 4°K prior to warmup following electron, neutron, and gamma irradiations at temperatures ranging from 77 to 350°K. The irradiated glasses displayed three distinct ESR spectra. The spectrum of gamma irradiated polycrystalline rutile GeO_2 was composed of a single resonance. After irradiation with neutrons, two additional signals were detected. The spectra observed in the glasses and polycrystalline rutile GeO_2 were simulated using a computer and assuming $S = \frac{1}{2}$ and $I = 0$. On the basis of the calculated g values, spin concentrations, and oxidation–reduction treatments, five of the magnetic complexes were attributed to intrinsic defects. Models are singly charged oxygen vacancies, Ge^{3+}, and O^- or O_2^- ions located at sites having different symmetries. Hexagonal single crystals of GeO_2 irradiated with electrons exhibited two complexes, which were correlated to two complexes in the glasses. A crystal irradiated with neutrons at 140°K displayed an additional complex whose properties were described by a spin Hamiltonian with $S = 1$. The data were consistent with the hypothesis that this paramagnetic state was due to a doubly charged oxygen vacancy. An as-received TiO_2 crystal exhibited an intense Fe^{3+} spectrum after a low-temperature gamma irradiation. After irradiation with neutrons at 140°K, an ESR spectrum due to three distinct magnetic species was resolved. Upon warming to room temperature followed by a gamma irradiation at 77°K, a new and very intense resonance was observed. Weak satellite lines were most consistently explained as due to hyperfine interaction with ^{47}Ti and ^{49}Ti. A reduced TiO_2 crystal, before and after a gamma irradiation at 77°K, had a spectrum with no resemblance to that of the as-received crystals. After irradiation with neutrons at 140°K, the spectrum was identical to that of the neutron-irradiated as-received crystals. Good agreement between the observed orientation dependence and that calculated from a spin Hamiltonian with $S = \frac{1}{2}$ was found for each species. On the basis of concentrations, g values, and hyperfine interactions, models for the resolved centers are proposed. These are singly charged oxygen vacancies and Ti^{3+} at various interstitial and substitutional sites. Single crystals of SnO_2 exhibited resonances attributed to impurities. No new spectral components were observed after electron irradiations at 77°K or neutron irradiations at 140°K. (auth)

44214 (ORNL-tr-1794) STUDIES OF THE EMISSION OF POSITIVE SECONDARY IONS FROM SOLID TARGETS. THE USEFULNESS OF THE ION-BOMBARDMENT ION SOURCE IN MASS SPECTROSCOPY. Beske, H. E. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Z. Naturforsch., 22A: 459-67(1967). 15p. Dep. CFSTI.

If solids are bombarded by ions, positive secondary ions (SI) of all elements of the target material are emitted. The mass analysis of these SI permits conclusions to be drawn about the composition of the target material. An arrangement based upon this kind of ion production is called an ion-bombardment ion source. In this paper it was investigated whether or not this ion source is suitable for quantitative analysis of solids by mass spectrometry. For this purpose the SI yield γ^+ of 27 elements was measured at constant bombardment conditions (12 keV Ar^+ ions, 45° incidence). γ^+ is approximately 1% for 10 elements — Si, Mn, Fe, Co, Ni, Rh, Ta, W, Os, and U. Aluminum shows the largest, gold the smallest SI yield. Yields differ by a factor of 1000 for different elements. The influence of the ionization energy on the SI yield is discussed. The yield is independent of the concentration in the range 0.02 to 20%. (auth)

44215 (SC-DC-68-2295) EFFECT OF PRESSURE ON SPIN-ORBIT COUPLING AND THE FERMI SURFACE OF Cd. Schirber, J. E.; O'Sullivan, W. J. (Sandia Corp., Albuquerque, N. Mex.). Aug. 1968. Contract AT(29-1)-789. 4p. (CONF-680808-3). Dep. CFSTI.

From Conference on Low Temperature Physics, St. Andrews, Scotland.

The effects of hydrostatic pressure on several features of the Cd Fermi surface were studied for applied magnetic field directions along or near [0001]. Measured pressure derivatives are presented for the α, β, and γ cross sections of the Fermi surface; the measurements were made using the de Haas-van Alphen phase-shift technique at 1 to 4°K. The results are compared with those expected from the analogy with Zn and nearly free electron considerations. (D.L.C.)

44216 (UCRL-18158) ANOMALOUS ABSORPTION OF ELECTRONS. Bell, Walter Lee (California Univ., Berkeley. Lawrence Radiation Lab.). May 1968. Contract W-7405-eng-48. 189p. Dep. CFSTI.

Thesis.

The two-beam theory of electron diffraction in absorbing crystals is developed and its applicability to real diffracting media is investigated using electron micrographs of wedge-shaped foils of silicon and aluminum, obtained in a 100,000-V electron microscope. The anomalous absorption phenomenon believed to exist would be evidenced in electron micrographs by a significantly greater intensity of electrons being passed through a diffracting crystal than would be possible if only a simple mean linear absorption parameter were present. An anomalous absorption parameter is also predicted to exist, but the methods for measuring this parameter ignore the presence of diffuse background intensity which can simulate the effects of the anomalous parameter. Using microphotometer traces obtained from the electron micrographs it is determined, by canceling background contributions to the intensity and by empirical methods, that the anomalous parameter exists and that the values obtained by conventional methods are usually wrong and influenced to a great extent by the magnitude and distribution of diffuse radiation, which in turn depends upon the diffracting material, the surface condition of the material, and the manner in which the electron microscope is operated to control inherent divergence in the incident beam. Evidence is presented that low-energy-loss electrons, assumed by the theory to be absorbed, actually re-enter the dynamical beams, effectively amplifying the information carried by these beams. Such re-entrainment of electrons makes the apparent incident intensity and the apparent mean parameter increase with foil thickness. However, the average mean parameter is found to be a crystal constant and independent of the diffracting planes. The anomalous parameter is found not to be a crystal constant and depends upon the specific diffracting planes and, in addition, upon the structure of the diffracting crystal. In fcc aluminum, the anomalous absorption length increases with higher-order diffracting planes in such a way that the ratio of the imaginary part of the Fourier coefficient of the lattice potential to the real part is fairly constant. In silicon, the irregularly spaced (111) diffracting planes exhibit less anomalous absorption than do the regularly spaced (220) planes. It is shown that the single most important influence upon measured absorption parameters is divergence in the incident beam, which can be lessened by defocusing the condenser lens of the microscope. Well-defocused incident illumination gives micrographs whose intensity profiles are very well developed, and can be used to obtain consistent absorption parameter measurements. (auth)

44217 (UCRL-18278) NUCLEAR MAGNETIC AND NUCLEAR QUADRUPOLE DOUBLE RESONANCE IN SOLIDS. Schwab, Michael (California Univ., Berkeley. Lawrence Radiation Lab.). July 1968. Contract W-7405-eng-48. 156p. Dep. CFSTI.

Thesis.

Presented is a new scheme for a sensitive nuclear double resonance detection. An ordered quadrupole system (A) is used to both establish and monitor a metastable state of a second abundant spin system (B). Because of the long relaxation time of this metastable state it is possible to perform a sensitive double resonance between the B spin system and a third rare or weakly interacting system (C). This technique was applied to a deuterated (~12%) sample of paradichlorobenzene. The ^{35}Cl reservoir acts as the A system. The B proton system has a zero-field lifetime of 46 seconds, and approximately a one-hour lifetime at 135 gauss. The C systems investigated are (1) the deuterium system and (2) the naturally abundant ^{13}C nuclei. The measurements of the deuterium resonance are the first reported for paradichlorobenzene. A discussion of the general problem of double resonance detection of integer spin systems is given and shows that for a well resolved η splitting, a double resonance cannot be detected owing to the nonsecular character of the cross relaxation term. The observation of the ^{13}C resonance is the first reported observation through nuclear magnetic resonance techniques of the 1.1% abundant ^{13}C in a solid. The general considerations for the nuclear Zeeman and quadrupole spin systems are discussed. The various prepared states of both these systems and the means by which the C system is saturated are given in detail. The double resonance conditions are detailed and discussed with respect to integer spin systems. The formal cross-relaxation equations are also given. (auth)

44218 STUDY OF SOLID ELECTROLYTES WITH ZIRCONIUM OXIDE BASE FOR REACTOR FUELS. Tannenberger, H.; Schachner, H.; Kovacs, P. (Battelle Institut, Geneva). Rev. Energ. Primaire, 2: 19-26(1966). (In French).

The electrolytic properties of $ZrO_2-Nd_2O_3$, $ZrO_2-Gd_2O_3$ and $ZrO_2-Yb_2O_3$ systems, ranging from 6 to 20% rare earth content have been investigated. The total conductivity reaches a maximum, at a given temperature, for the composition corresponding to the lowest content of rare earth oxide necessary to the stabilization of the cubic phase. The highest values of this maximum are obtained with the $ZrO_2-Yb_2O_3$ system. The electronic conductivity of the studied electrolytes is lower than 1% of the total conductivity. (auth)

44219 MAGNETIC PROPERTIES OF CERIUM TELLURIDES. Pechennikov, A. V.; Chechernikov, V. I.; Barykin, M. E.; Chukalin, V. I.; Yarembash, E. I. (Moscow State Univ. Inst. of General and Inorganic Chemistry, Moscow). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 986-7(June 1968). (In Russian).

The temperature dependence of the magnetic susceptibility of Ce_3Te_4, Ce_2Te_3, Ce_4Te_7, Ce_2Te_5, and $CeTe_3$ measured in the interval from 80 to 1000°K is shown graphically. The effective atomic magnetic moments and the Weiss constants of the tellurides were calculated, and the results are tabulated. (J.S.R.)

44220 MOSCOW UNIVERSITY STUDIES OF NEW MAGNETIC ORDERING OF SUBSTANCES. Belov, K. P. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 5, 23-31(Sept.-Oct. 1967). (In Russian).

A brief review is given of the available data on lanthanide ferro- and ferrimagnetics. Magnetic anisotropy hysteresis properties of rare earths (Sm, Gd, Tb, Dy, Ho, Er, Tm, and Yb) and spin-orbit interaction energy and spallation of ions of the elements above are tabulated. Angular magnetic structures of the ferro- and ferrimagnetics studied are discussed. (R.V.J.)

44221 ELECTRONIC STRUCTURE OF ALLOYS AND INTERMETALLIC COMPOUNDS. Wallace, W. E. (Univ. of Pittsburgh). Progr. Sci. Technol. Rare Earths, 3: 1-37(1968).

The magnetic, thermal, and structural characteristics of alloys and intermetallics containing the rare earth elements have been extensively studied in recent years. This body of subject matter is reviewed with principal emphasis on magnetic behavior. The review is selective in the sense that emphasis is focussed on those investigations which lead to useful information concerning the electronic make-up of the component elements, and is not confined to a particular time span. The aspect of electronic structure which is emphasized is the number and distribution of electrons in the ion cores. Some attention is also given to the electrons in the conduction band. (UK)

44222 NUCLEAR MAGNETIC RESONANCE (NMR) SPECTROSCOPY. Peterson, W. G. (Enfield Coll. Tech., Eng.). Meas. Instrum. Rev., 15: 423-7(June 1968).

Part II of review article. Headings are as follows: Methods of detecting and displaying resonance information (single coil method, two coil method); double irradiation; some applications of NMR (analytical applications, quantitative analysis, structural and stereochemical analysis, theoretical and physical chemical studies); advances and trends in NMR (new instruments, variable temperature facilities, use of microcell for small sample volume, spectrum summation, pulse-modulated nuclear magnetic resonance spectroscopy). (UK)

44223 NUCLEAR MAGNETIC RESONANCE (N.M.R.) SPECTROSCOPY. Peterson, W. G. (Enfield Coll. of Tech., Eng.). Meas. Instrum. Rev., 15: 299-303(May 1968).

A review is given under the following headings: NMR—the phenomena; history and development of the method; basic theory of the resonance condition (frequency of energy quanta required for transition between energy levels, precessional frequency, shielding effects and chemical shift, spin-spin coupling); AX and AB systems; instrumentation (high-stability magnetic field, source of radio-frequency energy, and sweeping the spectral region). It is noted that a continuation of this review will be published later. (UK)

44224 EFFECT OF FAST NEUTRON IRRADIATION ON THE PHOTOMECHANICAL EFFECT IN SILICON. Makarevich, A. I.; Berezina, G. M.; Shibko, L. S. (Inst. of Solid State Physics and Semiconductors, Minsk). Dokl. Akad. Nauk BSSR, 12: 417-18 (May 1968). (In Russian).

The effect of fast neutrons at different irradiation temperatures on the change of the photomechanical effect of monocrystalline silicon was investigated. An increase of the photomechanical effect with fast neutron irradiation is explained. The increase of the irradiation temperature promotes an increase of the photomechanical effect. (tr-auth)

44225 SOLUBILITY AND DIFFUSION COEFFICIENT OF TRITIUM IN SINGLE CRYSTALS OF SILICON. Ichimiya, Torao; Furuichi, Akio (Inst. of Physical and Chemical Research, Saitama Perfecture, Japan). Int. J. Appl. Radiat. Isotop., 19: 573-8 (July 1968).

The samples employed were of p-type silicon, with a resistivity of 150 Ω cm and with dimensions of $10 \times 5 \times 2 \sim 0.5$ mm. The samples were put into fused silica ampoules and tritium, under 100 mm Hg and at 20°C, was introduced. The ampoules were then heated at 900 ~ 1200°C for an hour. The samples thus prepared were placed in another ampoule connected to a gas ionization chamber, heated at 1000°C and the total amount of tritium evolved from the silicon was estimated. The solubility was expressed by: $S = 1.6 \times 10^{20} \exp(-34000/RT)$ atoms cm^{-3} under 1 atm of tritium. The diffusion coefficient, D, was also estimated from the outdiffusion of tritium at 400 ~ 500°C: it was given by: $D = 4.2 \times 10^{-8} \exp(-13000/RT)$ cm^2 sec^{-1}. (auth)

44226 DIFFRACTION CHANNELING OF PROTONS. Chadderton, Lewis T. (North American Rockwell Corp., Thousand Oaks, Calif.). Thin Films, 1: 157-81(Mar. 1968).

The experimental features of patterns obtained on either sensitive film or a fluorescent screen when energetic protons are transmitted, reflected, or emitted from a single crystalline specimen are compared with those obtained with electrons, and from the gross similarities observed it is concluded that the same physical process is operating in each case. For protons modified Kikuchi patterns are produced by the elastic scattering of inelastically scattered particle waves, suggesting that a quantum mechanical interpretation of the basic phenomenon coexists with the more familiar classical interpretation, and that there is a regime of "correspondence" for scattering of a particle by a periodic medium. (auth)

44227 EVIDENCE FOR AN ITINERANT ELECTRON MOMENT IN CUBIC LAVES-PHASE RARE-EARTH–TRANSITION-METAL COMPOUNDS. Piercy, A. R.; Taylor, K. N. R. (Univ. of Durham, Eng.). J. Phys., C, 1: 1112-17(Aug. 1968).

The magnetic properties of the series of pseudo-binary compounds YFe_uCo_{2-u} were examined in an attempt to obtain further information concerning the nature of the transition metal moment in the cubic Laves-phase rare earth–transition metal compounds. The variation of the observed moment throughout the series can be understood on the basis of a nonlocalized moment associated with the transition metal ion. The variation of the Curie temperature may be associated with the variation of the lattice parameter between the terminal compounds. (auth) (UK)

44228 ANNEALING AND RE-IRRADIATION BEHAVIOUR OF THE F BAND IN LITHIUM FLUORIDE BETWEEN 80 ^{0}K AND 300 ^{0}K. Comins, J. D.; Wedepohl, P. T. (Univ. of Witwatersrand, Johannesburg). J. Phys., C, 1: 906-12(Aug. 1968).

Lithium fluoride samples from two different sources were irradiated at 81°K and then warmed to room temperature. Three annealing stages of the F band were found in this temperature range. Stages I and III (at about 120 and 250°K, respectively) have been found by previous authors, whereas stage II (at about 180°K) has not been reported before. The samples were also warmed to several temperatures between 81°K and room temperature after irradiation, then recooled to 81°K and reirradiated. Both the annealing behavior and the re-irradiation behavior of the F band were found to be markedly sample-dependent. An optical absorption band which has not been previously reported was found after irradiation at 81°K. This band, which had its peak at 415 nm, annealed at about 100°K. (auth) (UK)

44229 THEORY OF NUCLEAR RESONANT DIFFRACTION OF GAMMA RAYS BY PERFECT CRYSTALS. O'Connor, D. A. (Univ. of Birmingham, Eng.). J. Phys., C, 1: 973-8(Aug. 1968).

The dynamical theory of x-ray diffraction is adapted to the case of nuclear resonant diffraction of Moessbauer radiation. It is found that the dispersion surfaces for the Laue and Bragg conditions of incidence are markedly different and that anomalous transmission occurs in both cases. The effect of the accompanying electronic scattering is to increase the anomalous absorption coefficient. The integrated reflecting power in both Laue and Bragg cases is found to be roughly proportional to the modulus of the total scattering amplitude. (auth) (UK)

44230 OPTICAL AND ELECTRON-SPIN-RESONANCE STUDIES OF THE ICl^-V_K CENTER IN KCl:I. Goldberg, Lawrence S.; Meistrich, Marvin L. (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 172: 877-85(Aug. 15, 1968).

The ICl^- V_K center, a ⟨110⟩-oriented self-trapped hole center, has been investigated in x-irradiated KCl:I and KCl:I:Pb at low temperatures by optical and electron-spin-resonance techniques. Three optical transitions are identified at 430, 840, and 1000 nm by anisotropic absorption measurements; their observed σ polarizations and relative intensities are consistent with a molecular-orbital model modified for XY^- molecule-ion centers. Pulse-annealing experiments monitored by ESR and correlated with thermoluminescence data and absorption-spectrum changes give information on the formation and thermal stability of ICl^-. An improved analysis of the ESR spectrum has been carried out, taking into account deviations from axial symmetry. Perturbation theory calculations are extended to include some terms to fourth order. The observed $|\Delta m| = 1,2$ forbidden transitions are fitted with these equations, allowing a determination of the sign, as well as the magnitude, of the large iodine quadrupole interaction. (auth)

44231 ISOTOPE EFFECT IN VERY WEAK ITINERANT FERROMAGNETS. Hopfield, J. J. (Princeton Univ., N. J.). Phys. Lett., 27A: 397-9(Aug. 12, 1968).

In ordinary ferromagnetism, the dynamics of phonons plays no role. It is shown that in the case of weak itinerant ferromagnetism, phonon dynamics may play a significant role, resulting in an isotope effect on T_c. (auth)

44232 GENERALIZED SUSCEPTIBILITIES AND MAGNETIC ORDERING OF HEAVY RARE EARTHS. Evenson, W. E.; Liu, S. H. (Ames Lab., Iowa). Phys. Rev. Lett., 21: 432-4(Aug. 12, 1968). (IS-1810).

The generalized magnetic susceptibilities, $\chi(\vec{q})$, have been calculated along the line Γ to A for the heavy rare-earth metals, Gd, Dy, Er, and Lu, using energy bands previously calculated by Keeton and Loucks. The initial ordering periodicity for each of these metals can be related to Fermi-surface geometry by examining the maxima in the susceptibilities. Agreement with experimental magnetic wave vectors is satisfactory. (auth)

44233 EVIDENCE FOR A COOPERATIVE ELECTRON TRANSITION IN PLUTONIUM AT LOW TEMPERATURES. Rosen, M. (Nuclear Research Center-Negev, Beer-Sheva, Israel); Erez, G.; Shtrikman, S. Phys. Rev. Lett., 21: 430-1(Aug. 12, 1968).

The temperature dependence of the elastic moduli and ultrasonic attenuations of plutonium is not consistent with the antiferromagnetism hypothesis for this metal at low temperatures. The elastic and anelastic behavior of plutonium indicates the possible existence of a cooperative electron transition at 66°K. (auth)

44234 STUDY BY MOESSBAUER EFFECT OF A 50 TO 50 Fe-Ni MONOCRYSTAL ORDERED BY NEUTRON IRRADIATION. Gros, Yves; Pauleve, Jean; Dautreppe, Daniel; Pebay-Peyroula, Jean-Claude (Domaine Univ., Saint-Martin-d'Heres, France). Compt. Rend., Ser. A and B, 266: 1199-1201(Apr. 29, 1968). (In French).

The experimental study of the Moessbauer spectrum of irradiated Fe-Ni showed the contribution of dipolar fields to the internal field. The relative simplicity of the hypotheses describing the structure of the sample should permit a comparison between the experimental results and a theoretical study on the value of the various contributions. (J.S.R.)

44235 OPTICAL TRANSITIONS IN RARE EARTH CRYSTALS. Gruber, John B. (Washington State Univ., Pullman). Progr. Sci. Technol. Rare Earths, 3: 38-60(1968).

There is an increasing interest in the interpretation of the optical transitions of paramagnetic ions having unfilled f shells in crystals. A study of the magnetic, thermal, and optical properties of rare earth salts, indicating sharp and distinct groupings of lines in absorption and fluorescence spectra, presents a challenge to consider possible mechanisms which could conceivably explain the number, position, line shape, and intensity of the observed optical transitions. A review of work in this field is presented. (UK)

44236 DISPERSIVE ANHARMONIC EFFECTS IN THE LATTICE DYNAMICS OF QUANTUM CRYSTALS WITH HARD-CORE POTENTIALS. Meissner, Guenther (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Lett., 21: 435-7(Aug. 12, 1968).

A simple approach to lattice dynamics provides a treatment of noninstantaneous (dispersive) anharmonicities in highly anharmonic crystals with singular (hard-core) interparticle potentials. The theory may be used to study the balance between single-particle and collective motions (phonons) in solid helium. (auth)

44237 RADIATION SPUTTERING OF A SINGLE CRYSTAL OF GOLD BY FAST NEUTRONS. Garber, R. I.; Dolya, G. P.; Kolyada, V. M.; Modlin, A. A.; Fedorenko, A. I. (Physico-Technical Inst., Kiev). JETP Lett. (USSR) (Engl. Transl.), 7: 296-7 (May 20, 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 7: 375-8(May 20, 1968).

The question of whether atomic collision focusing causes anisotropy of the sputtering of atoms from a gold crystal bombarded by fast neutrons is investigated. The experiment was performed with a 14-MeV neutron beam of 10^8 cm^{-2} sec^{-1} intensity, obtained via the D-T reaction from the neutron generator. The angular distribution of the sputtered atoms in the residue of the screen was determined by autoradiography. The observed preferred emission of the sputtered particles in low-index crystallographic directions confirms the existence of a collision-focusing mechanism in neutron bombardment of crystals. (M.H.R.)

44238 STRUCTURAL AND SOLID-STATE CHEMISTRY OF PURE RARE EARTH OXIDES AND HYDROXIDES. Brauer, Georg (Univ., Freiburg i. B.). Progr. Sci. Technol. Rare Earths, 3: 434-58(1968).

A summary of progress in this field since about 1964 is given. The sectional division is: sesquioxides, higher oxides, lower oxides, and hydroxides and oxide hydroxides. (auth) (UK)

44239 STATISTICS OF THE ATOMIC PARTICLE-INDUCED ELECTRON EJECTION FROM SOLIDS. Greupner, Heinz (Humboldt Univ., Berlin). Z. Phys., 214: 427-36(1968). (In German).

Measured probability distributions of the electron ejection from solids due to bombardment by atomic particles with kinetic energy are compared with theoretical distributions. With regard to the applied measuring parameters, it is shown that best adaption is obtainable by use of one of the suggested theoretical distributions respectively. A heuristic foundation is given for this fact, and the assumption is confirmed that careful measurements of the probability distributions are additional sources of information with regard to the investigation of the atomic particle-induced electron ejection. (auth)

44240 METHOD FOR COLORATION OF LITHIUM FLUORIDE BY 25-keV ELECTRONS. Monpagens, Jean-Claude (CNRS, Toulouse). Compt. Rend., Ser. A and B, 266: 1607-10(June 24, 1968). (In French).

The creation of color centers in alkali metal halides by electron bombardment is accompanied by a luminescence of the crystal in which the shading varies in the course of the irradiation. In the case of LiF it passes successively from blue to rose then to yellow. The simultaneous study of the variation of optical absorption and the color variations of the luminescence permits one to propose a method for the process of coloration. (tr-auth)

44241 INFRARED ABSORPTION SPECTRUM OF POTASSIUM CHLORATE IRRADIATED BY X RAYS. Jumeau, Daniel; Fayet, Jean-Claude (CNRS, Orsay, France). Compt. Rend., Ser. A and B, 266: 1614-17(June 24, 1968). (In French).

Two families of ClO_2^- radicals are pointed out. One can also show the existence of the ClO_4^- ion. (tr-auth)

44242 REFLECTANCE AND $1/\epsilon$ RESONANCE OF BERYLLIUM IN THE FAR ULTRAVIOLET. Toots, J.; Fowler, H. A.; Marton, L. (National Bureau of Standards, Washington, D. C.). Phys. Rev., 172: 670-6(Aug. 15, 1968).

The reflectance of evaporated Be layers has been measured after 3-min exposure to ambient pressures of $\leq 3 \times 10^{-7}$ torr, for the wavelength range of 480 to 1200 Å, for a spread of angles between 20 and 80°. These values give n and k by calculation; also, from these ϵ_1, ϵ_2, $Re(1/\epsilon)$, and $Im(1/\epsilon)$ are obtained. The last two functions show good agreement with an inverted Drude-Sellmeier resonance formula. The center frequency of the resonance falls at 18.4 ± 0.1 eV, corresponding to the natural plasma-resonance frequency of a free-electron gas with 2.0 electrons per atom; this confirms a 1948 prediction by A. Bohr. The half-width of the resonance is measured as 4.7 ± 0.1 eV; this value is also obtained, within ±10%, from a sum-rule approximation, and is thought to represent an upper limit of the systematic error. This value corresponds to a decay time (for intensity) of the plasma oscillation of about 1.3×10^{-16} sec. An Argand-diagram display of the data is given, and the "longitudinal" Kramers-Kronig relationship is demonstrated. (auth)

44243 ANTIFERROMAGNETISM OF URANIUM AND THORIUM PHOSPHIDES. Chechernikov, V. I.; Shavishvili, T. M.; Pletyushkin, V. A.; Slovyanskikh, V. K. Zh. Eksp. Teor. Fiz., 55: 151-6(July 1968). (In Russian).

The magnetic properties of solid solutions of the UP-ThP and UP_2-ThP_2 systems are studied. Antiferromagnetism exists in uranium monophosphide systems up to 50 at.% of ThP. With increase of the ThP content, the Neél temperature drops from 129°K for UP to 115°K for a sample containing 50 at.% of ThP. The Curie-Weiss law is valid in the paramagnetic region. The paramagnetic Curie temperature $\Theta_p > 0$ and decreases with dilution, tending to zero. For infinite dilution the effective magnetic moment $\mu_{eff} = 2.7\ \mu_B$. Above 200°K the uranium diphosphide alloys are antiferromagnetic. X-ray-diffraction studies show that all the alloys form solid solutions. In alloys of the UP-ThP system possessing a structure of the NaCl type, the lattice constant grows with increase of the thorium content. The UP_2-ThP_2 alloys possess a structure of the Cu_2Sb type. (auth)

44244 ISOMER SHIFTS OF THE MOESSBAUER γ LINE IN TRIVALENT ANTIMONY HALIDES. Kotkhekar, V.; Iofa, B. Z., Semenov, S. I.; Shpinel, V. S. Zh. Eksp. Teor. Fiz., 55: 160-3 (July 1968). (In Russian).

The isomer chemical shift (ICS) of the ^{121}Sb 37.2-keV Moessbauer γ line in trivalent antimony halides was measured. By comparing the ICS values for the tri-and pentavalent antimony compounds $SbCl_3$ and $HSbCl_6 \cdot xH_2O$ the value of $\Delta r/r$ (change of nuclear charge radius due to excitation) is obtained for ^{121}Sb which is equal to $(-9.5 \pm 3) \times 10^{-4}$. The ICS for $SbHal_3$ compounds linearly increases with growth of ionicity of the bonds β. From a comparison of the observed slope of the straight line for the dependence of ICS on β with the calculated value it follows that the change of the density $\psi_{5s}(0)^2$ due to screening by valence electrons in these compounds is insignificant. (auth)

44245 APPLICATIONS OF THE MOESSBAUER EFFECT TO SILICATE MINERALOGY. II. IRON SILICATES OF UNKNOWN AND COMPLEX CRYSTAL STRUCTURES. Bancroft, G. Michael (Univ. of Cambridge, Eng.); Burns, Roger G.; Stone, Anthony J. Geochim. Cosmochim. Acta, 32: 547-59(May 1968).

Measurements were made of the Moessbauer spectra of howieite, deerite and two sapphirines, for which the crystal structures are unknown, and also zussmanite and the alkali amphibole crocidolite. Computer analyses of the spectral data for each silicate yielded values for the chemical shift and quadrupole splitting for each doublet in the Moessbauer spectra. These parameters are correlated with those for iron ions in silicates of known crystal structures to give information on the oxidation state, electronic configuration, and coordination site of each iron atom in the structures. High spin iron was found in all minerals studied. All minerals studied, except one sapphirine, contain at least one structurally distinct type of Fe^{2+} ion in sixfold coordination, while deerite contains Fe^{2+} ions in fourfold coordination. Howieite, deerite, and crocidolite contain Fe^{3+} in sixfold coordination, while sapphirines contain Fe^{3+} in fourfold coordination. Computer calculated areas in the Moessbauer spectra were used to estimate the fraction of each iron species in a structure giving rise to absorption, assuming that the area under a peak is directly proportional to the amount of iron in a site. The results for Fe^{2+} and Fe^{3+} containing minerals agree well with chemical analysis values. The area data have allowed Fe^{2+} site populations to be determined in the crocidolite structure. (auth)

44246 GROWTH AND ELECTRICAL RESISTIVITY CHANGE OF URANIUM BY THERMAL NEUTRON IRRADIATION AT 4.6°K. Goller, S. (Technische Hochschule, Munich); Vogl, G.; Wenzl, H.; Jousset, J. C. Phys. Lett., 27A: 408-9(Aug. 26, 1968).

In-pile length measurements of α uranium at 4.6°K have shown that the growth coefficient G varies considerably with the burnup, in agreement with Leteurtre's model. The initial value of G is higher than 250,000. The electric-resistivity increase reaches saturation after a dose of 10^{17} n/cm^2. (auth)

44247 ABSOLUTE ATOMIC SCATTERING FACTORS OF TUNGSTEN. Paakkari, T.; Suortti, P. (Univ. of Helsinki). Phys. Status Solidi, 28: 539-45(Aug. 1, 1968).

The atomic scattering factors f of tungsten are determined in the region $\sin \theta/\lambda \leqq 1.1$ Å^{-1} from the integrated intensities of Bragg reflections. The reflections from a powder sample were measured at 300°K with monochromatic Mo Kα radiation. The intensities are corrected for the effects of porosity and surface roughness, and for the contribution of thermal diffuse scattering. The intensities are put on an absolute scale with respect to the absolute value f(110) of iron. The mass absorption coefficient of tungsten for Mo Kα radiation is measured to be $\mu_\rho = (101.8 \pm 0.4)$ cm^2/g. A value for the temperature parameter of $B_W = (0.183 \pm 0.008)$ Å^2 is obtained by a measurement of the integrated intensity of a high-order reflection both at 300 and 78°K. This corresponds to the Debye temperature $\Theta_M = (325 \mp 7)$°K. The experimental f-values are compared with various theoretical calculations. It is found out that the Dirac–Slater values are in excellent agreement with present results. (auth)

44248 EPR AND THERMOLUMINESCENCE MEASUREMENTS OF $CaWO_4$ CRYSTALS. Born, G. K.; Grasser, R. J.; Scharmann, A. O. (Justus-Liebig Univ., Giessen, Ger.). Phys. Status Solidi, 28: 583-8(Aug. 1, 1968).

After irradiation with x rays in the energy range 50 to 150 keV at the temperature of liquid air, paramagnetic centers are created in single crystals of $CaWO_4$. The center with a spectroscopic splitting factor slightly higher than g = 2 originates from a hole stably trapped between two tungstate tetrahedrons. The signal of the corresponding electron is broad and rather difficult to detect. The concentration of these centers depends linearly on the dose of irradiation. The decrease of the EPR signal of the hole and electron centers with temperature is correlated with the thermoluminescence intensity. (auth)

44249 ELECTRON IRRADIATION AND RECOVERY OF TUNGSTEN. Neely, H. H. (Atomics International, Canoga Park, Calif.); Keefer, D. W.; Sosin, A. Phys. Status Solidi, 28: 675-82(Aug. 1, 1968).

Damage rates and recovery of 99.99% pure tungsten have been investigated after electron irradiation near 4°K by means of electrical resistivity. The damage rate data tend to a value of T_0 = 38 to 42 eV. The recovery of the residual electrical resistivity shows three major stages: Stage I from 4.2 to 100°K, Stage II from 100 to 500°K, Stage III from 500 to 1000°K. Stage I is dominated by only one major peak at 70°K. An analysis based on second-order kinetics yielded a good fit to the data through 95% of the recovery. The energy derived was 0.17 eV. Only ≈26% recovery is seen in Stage I and it is proposed that the suppression is due to interstitial trapping by impurities. Stage III accounts for about 40% recovery of the induced resistivity and has a center temperature of 760°K. The stage was analysed assuming second-order kinetics; this analysis gave an energy of 1.1 eV. (auth)

44250 R_N AND N CENTERS IN NaF CRYSTALS IRRADIATED WITH PROTONS AT LIQUID NITROGEN TEMPERATURE. Kikuchi, A.; Ozawa, K. (Japan Atomic Energy Research Inst., Tokyo). Phys. Lett., 27A: 443-4(Aug. 26, 1968).

The effects of thermal annealing on the R_N absorption bands at 570 and 632 nm induced in NaF crystals by warming to room temperature after proton irradiation at liquid nitrogen temperature, have been investigated. The R_N centers each display a characteristic transformation to the N centers of F_4 model at about 393°K. (auth)

44251 INTENSITY AND RESOLUTION IN NEUTRON TIME-OF-FLIGHT POWDER DIFFRACTOMETRY. Buras, Bronislaw (Univ. of Warsaw); Holas, Andrzej. IAEA Contract 255/RB. Nukleonika, 13: 591-620(1968).

As has been shown in recent years, the time-of-flight method can be applied to neutron structure analysis of powdered crystals. Mathematical expressions have been developed allowing to calculate the integrated intensities and half-widths of reflections as functions of parameters of the experimental set-up, i.e., the scattering angle, the parameters of the chopper, the flight-path, the shape and dimensions of the sample, the dimensions of the counter, collimators etc. Based on these expressions a procedure of optimization of the experimental conditions has been developed. (auth)

44252 OPTICAL CONSTANTS OF ANISOTROPIC MATERIALS FROM ENERGY-LOSS EXPERIMENTS. Bassani, F.; Tosatti, E. (Scuola Normale Superiore, Pisa, Italy. Istituto dei Fisica, Pisa, Italy). Phys. Lett., 27A: 446-7(Aug. 26, 1968).

A Kramers–Kronig analysis of electron energy loss is shown to allow a calculation of the optical constants of anisotropic materials. The analysis is carried out for graphite and the optical constants along the c axis are obtained between 5 and 30 eV. (auth)

44253 THE STRUCTURE OF ANTIFERROMAGNETIC UO_2. Cracknell, A. P. (Univ. of Essex, Eng.). Phys. Lett., 27A: 426-7(Aug. 26, 1968).

It is suggested that the nearly isotropic weak ferromagnetism in UO_2 may be explained by assuming a canted antiferromagnetic structure (ϕ between 0.2° and 0.4°), together with the existence of domains. (auth)

44254 MOESSBAUER EFFECT FOLLOWING COULOMB EXCITATION OF ^{183}W. Hardy, K. A.; Russell, D. C.; Wilenzick, R. M. (Tulane Univ., New Orleans). Phys. Lett., 27A: 422-3(Aug. 26, 1968).

The Moessbauer effect of the gamma radiation from the 46.5-keV state of ^{183}W has been observed following Coulomb excitation with 3.3-MeV protons. The spectrum is a single line with maximum absorption 8.1 ± 0.5% at 77°K and half width 4.72 ± 0.24 cm/sec. (auth)

44255 STUDY OF THE DYNAMIC POLARIZATION OF PROTONS. Swanenburg, Teunis Johannes Boudewijn. Leiden, Univ. of Leiden, 1967. 135p.

Thesis.

Work concerned with the dynamic polarization of protons in dilute paramagnetic crystals in the temperature region between 1 and 4°K is described. The polarization process is investigated under different, well-defined experimental conditions to obtain information about the coupling of the protons with the electron spins of the sample. The collective behavior of spin systems under the influence of strong rf fields is also investigated. All polarization experiments were performed in single crystals of $La_2 Mg_3 (NO_3)_{12} \cdot 24H_2O$, to which certain amounts of paramagnetic rare earth ions were added. (TSS)

44256 APPLICATION OF COMPUTER TECHNIQUES TO THE INVESTIGATION OF OPTICAL PROPERTIES OF FOCUSING DEVICES AND TO THE CALCULATION OF COHESIVE ENERGY AND ELASTIC CONSTANTS OF IONIC CRYSTALS. Pettersson, Goeran. Uppsala, Uppsala Univ., 1968. 7p.

Thesis

A review is given on 16 published papers on the following subjects: focusing properties of long magnetic lenses (2 papers); Monte Carlo technique for investigations of the focusing properties of long magnetic lenses; method for integration of particle trajectories in an experimentally determined magnetic field; alternating-direction implicit method applied to the calculation of a magnetic field from a measured boundary; error in measurement of a magnetic field versus accuracy of computed particle trajectories—a system analysis; particle trajectories in magnetic fields—a comparison between calculated and experimental results; computer investigations of a double-focusing spectrometer and comparisons with experimental results; different computational approaches for the design of flat spectrometers; calculation of elastic constants of NaF; calculation of the cohesive energy and elastic constants of MgO; theoretical determination of the elastic constants of LiF; experimental and theoretical determination of the elastic constants of NaCl; calculation of the elastic constants of NaF with scaled atomic orbitals, cohesive energy and elastic constants of MgO with partially scaled wave functions; and calculation and plotting of the electron density of ionic crystals. (Swed)

44257 MICROWAVE-FREQUENCY DIELECTRIC PROPERTIES OF DIVALENT EUROPIUM OXIDES. Samokhvalov, A. A.; Ismailov, S. A.; Afanas'ev, A. Ya. (Metal Physics Inst., Sverdlovsk, USSR). Sov. Phys.-Solid State (Engl. Transl.), 10: 334-6 (Aug. 1968).

Translated from Fiz. Tverd. Tela, 10: 425-8(Feb. 1968).

The complex permittivity (at 9400 Mc) and the static electrical conductivity of single-crystal and polycrystalline samples of EuO, Eu_2O_3, Eu_3O_4, $3EuO \cdot Al_2O_3$, and $2EuO \cdot SiO_2$ were investigated in the temperature range 80−700°K. It was found that ϵ' of these oxides was within the limits 12 to 24 and it was constant (with the exception of $3EuO \cdot Al_2O_3$) in the investigated range of temperatures. When the temperature was increased, ϵ'' of polycrystalline EuO and of single-crystal and polycrystalline Eu_3O_4 increased linearly. The microwave conductivity of single crystals was equal to the static conductivity. The results are discussed briefly in relation to the mechanism of n-type conduction and the nature of microwave losses. (auth)

44258 SCATTERING OF NEUTRONS BY PARAMETRICALLY EXCITED SPIN WAVES. Gurevich, A. G.; Drabkin, G. M.; Lazebnik, I. M.; Mal'tsev, E. I.; Marchik, I. I.; Starobinets, S. S. (Ioffe Physicotechnical Inst., Leningrad. Inst. for Semiconductors, Leningrad). Sov. Phys.-Solid State (Engl. Transl.), 10: 511-13 (Aug. 1968).

Translated from Fiz. Tverd. Tela, 10: 647-50(Feb. 1968).

The scattering of neutrons by magnons excited by an alternating magnetic field parallel to a constant field H_0, was studied. A polarized neutron beam was led into a $Y_3Fe_5O_{12}$ single crystal, perpendicular to the magnetic fields. The scattering in the presence and absence of the alternating field was measured; the difference (ΔN) showed a maximum at an angle close to the value of 3.25′ calculated from the theory of parametrically excited spin values. ΔN also shows a maximum at $H_0 = 470$ Oe, in agreement with calculations. It is concluded that scattering of slow neutrons by coherent parametrically excited spin waves was observed. (D.L.C.)

44259 INVESTIGATION OF THE INFLUENCE OF PROTON BOMBARDMENT ON THE ELECTRICAL RESISTANCE OF THIN SILVER FILMS. Chechetenko, V. V.; Tishchenko, L. P.; Fogel, Ya. M. (Physicotechnical Inst. for Low Temperatures, Kharkov). Sov. Phys.-Solid State (Engl. Transl.), 10: 502-4(Aug. 1968).

Translated from Fiz. Tverd. Tela, 10: 638-40(Feb. 1968).

The formation of defects in thin Ag films bombarded by 10 to 40-keV protons at 0.5-3 $\mu A/cm^2$ was studied by means of changes in the electric resistance. The films were maintained at temperatures as low as −158°C. For films irradiated at room temperature, there was no change in the resistance, while for the lower temperatures, the resistance increased with bombardment time. After bombardment, the resistance change ΔR would remain constant at the lower temperatures and decrease at the higher temperatures until it reached a constant value (zero at −13°C). The effects of λ/d (proton range in Ag/film thickness) on ΔR are described. The results are interpreted on the assumption that protons generate Frenkel's pairs and interstitial H atoms. (D.L.C.)

44260 INERT GAS ION BOMBARDMENT-INDUCED WORK FUNCTION CHANGES IN POLYCRYSTALLINE TUNGSTEN AND GOLD RIBBON. **Lawson, R. P. W.; Carter, G. (Univ. of Liverpool). Vacuum, 18: 205-11(Apr. 1968).**

The technique of energetic particle bombardment was used to investigate the properties of crystal lattice structures in solid targets, ion bombardment being a convenient method of introducing lattice damage. A technique of monitoring one surface parameter, namely the work function change, which may be induced in polycrystalline metals by low-energy inert gas ion bombardment, is described and used to show how post-bombardment annealing can restore the initial condition of the surface. Inert gas ion (He^+, Ar^+, Kr^+) bombardment in the energy range 100 to 600 eV was shown to induce work function changes in polycrystalline W and Au ribbon targets. Work function increases of several tenths of an electron volt in ion-bombarded W were annealed in stages corresponding to surface vacancy migration and gas release from the surface and parasurface regions of the target. Gas release at temperatures corresponding to bulk diffusion in W did not change the work function. Work function reductions in Au specimens were induced by inert gas ion bombardment which might be recovered during step-annealing at temperatures corresponding to surface lattice atom migration and to gas release stages corresponding to damage diffusion, normal diffusion, and bubble diffusion in Au. (BBB)

44261 SOME THERMOLUMINESCENT CHARACTERISTICS OF GAMMA IRRADIATED SOILS. Nishita, H.; Hamilton, M. (Univ. of California, Los Angeles). Soil Sci., 106: 76-84(Aug. 1968).

Thermoluminescence of nine soils that are widely different in chemical and physical characteristics and certain minerals and salts that may occur in soils was examined. Soils irradiated to 1,000 R with ^{60}Co gamma rays showed a wide range of thermoluminescence. Some of the soils studied showed only small amounts of thermoluminescence, while others showed large amounts. The glow curves of some soils showed one broad peak, while those of others showed two or three broad peaks. The maximum peak heights generally occurred in one or several of the following temperature ranges—around 150°C and within 285 to 295°C and 350 to 375°C. Certain minerals (vermiculite, kaolinite, bentonite, illite, and bauxite) and salts (Fe_2O_3, $CaCl_2$, $CaSO_4$, Al_2O_3, K_3PO_4, CaO, $CaCO_3$, Na_2CO_3 and NaCl) that may occur in soils also showed wide ranges of thermoluminescence. In most cases, the maximum peak heights for these materials occurred in one or more of the temperature ranges listed above for the soils studied. For a given soil, the shapes of the glow curves varied appreciably with gamma dose, but when the areas under the glow curves were plotted as a function of dose on logarithmic paper, sections of linearity were obtained. This indicated that the total energy absorbed was consistent with dose. The rates at which electron and hole traps of various depths were formed varied with the dose. More shallow than deep traps were formed with increasing dose. The decay of thermoluminescence, which was studied on one soil (stored at room temperature), occurred in three stages. The decay occurred at a rapid rate during the first 24 hr. It was slower, but still appreciable during the interval of 24 to 672 hr and then became quite slow. About 1.5 percent loss of thermoluminescence occurred during the time interval of 672 to 2,160 hr. (auth)

44262 MAGNETIC PROPERTIES OF URANIUM COMPOUNDS WITH ELEMENTS OF THE VA AND VIA GROUPS. I. COMPOUNDS OF UX TYPE. Grunzweig-Genossar, J.; Kuznietz, M.; Friedman, F. (Technion-Israel Inst. of Tech., Haifa). Phys. Rev., 173: 562-73(Sept. 10, 1968).

The magnetic properties of NaCl-type uranium compounds with group VA and group VIA elements are discussed. The assumption that J is a good quantum number is shown to be a good approximation for the ground multiplet of the uranium ion. The uranium ions are dealt with by the usual methods of crystal-field theory. They are assumed to be in the electrostatic field of their neighboring cations and conduction electrons and also to experience the exchange field of neighboring uranium ions. This model enables us to calculate the magnetic saturation moment in the ordered state and the susceptibility in the paramagnetic state. The results agree with experiment, except that the calculated (paramagnetic) magneton numbers of the Uvi compounds are higher than those measured. The computed (total) splittings of the ground state in those compounds are between 500 and 1200 cm^{-1}. The exchange interaction is derived from the Ruderman−Kittel−Kasuya−Yosida type of interaction and is used to explain the occurrence of the observed ferromagnetic and antiferromagnetic (type-I) ordering. The problems involved in such a model are discussed at length. A schematic band structure is proposed, the effective conduction electron mass being computed to be 3 to 9m, while the s–f coupling constant is 12 to 22 eV Å^3, appreciably larger than in lanthanide compounds. (auth)

44263 MOESSBAUER EFFECT IN EUROPIUM ALLOYS. Huefner, S.; Wernick, J. H. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 173: 448-53(Sept. 10, 1968).

The Mössbauer effect of the 21.7-keV γ line of ^{151}Eu has been employed to study the isomer shifts and the magnetic fields in Eu–Yb and Eu–Ba alloys. From these measurements the conduction-electron contribution to the hyperfine field in Eu metal due to the ion's own 4f electrons and due to the neighboring ions has been deduced. In addition, an explanation for the apparent lack of conduction-electron contribution to the hyperfine field in metallic Gd is offered. (auth)

44264 ACTIVATION ENERGY OF DEFECTS IN NEUTRON IRRADIATED SILICON. Price, J. C. (Standard Telecommunication Labs., Ltd., Harlow, Eng.); Kiss, A. E. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-15: No. 4, 3-5(Aug. 1968).

Annealing studies of defects introduced in Si by a fast neutron flux have been made, using planar transistor samples to follow changes in minority carrier lifetime. An activation energy of 1.2 ± 0.1 eV was obtained from measurements of annealing over the range 100 to 156°C. (auth)

44265 NMR STUDIES IN PARAMAGNETIC AND FERROMAGNETIC CrBe$_{12}$. Wolcott, N. M. (National Bureau of Standards, Washington, D. C.); Falge, R. L. Jr.; Bennett, L. H.; Watson, R. E. Phys. Rev. Lett., 21: 546-9(Aug. 19, 1968).

The bulk nature of the magnetization of CrBe$_{12}$ is verified and the paramagnetic Curie temperature of about 50°K confirmed by conventional high-field NMR in the ferromagnetic as well as in the paramagnetic state. The equality of the hyperfine constants in the ferromagnetic and paramagnetic states suggests true ferromagnetic ordering. Significant magnetization density on the Be sites is inferred. (auth)

44266 FARADAY ROTATION STUDIES IN MgO AND CaO COLOUR CENTRES. Kemp, J. C.; Ziniker, W. M.; Glaze, J. A. (Univ. of Oregon, Eugene). Proc. Brit. Ceramic Soc., No. 9, 109-23(July 1967).

From 9th Proceedings of the British Ceramic Society on Point Defects in Non-Metallic Solids, Brighton, England. See CONF-660956.

Optical Faraday rotation studies are shown to be a promising approach to the problem of analyzing color-center bands in MgO and CaO. Especially useful is a double-resonance method combining Faraday rotation with electron spin resonance. A preliminary survey is presented of the spectral rotation patterns $\theta(\lambda)$ of MgO and CaO at liquid-helium temperatures. Interesting structure is revealed associated with the F center, in the ultraviolet, and with several zero-phonon peaks in the visible region. In CaO, double resonance shows a pattern which is believed to locate the F band, centered at 3.7 ± 0.1 eV with a width about 0.2 eV. The p-state spin-orbit splitting Δ is negative, as in MgO and alkali-halide F centers. As computed from a simple rigid-shift formula, Δ is possibly of the order -70 cm^{-1}. (auth)

44267 POINT DEFECTS IN NON-METALLIC SOLIDS. 2. Proceedings of the British Ceramic Society, University of Sussex, Brighton, 26th–28th September 1966. Proc. Brit. Ceramic Soc., No. 9, 1-286(July 1967). (CONF-660956).

A total of 24 papers are presented under the following headings: identification of type and determination of concentration of point defects, mechanical properties, mass transport and precipitation, molecular solids, and radiation effects and associated phenomena. A separate abstract was prepared for the paper on Faraday rotation in MgO and CaO color centers. Eleven papers were previously abstracted in NSA; see NSA 21: 43664, 43673, 43674, 43679, 44184, 44185, 44186, 44187, 44188, 44189, and 44190. (D.L.C.)

For an abstract of the individual paper see: 44266.

44268 CERTAIN ELECTROPHYSICAL PROPERTIES OF RARE EARTH METAL HEXABORIDES. Samsonov, G. V.; Sorin, L. A.; Vlasova, M. V.; Shcherbina, V. I. (Inst. of Material Study Problems, Moscow). Dokl. Akad. Nauk SSSR, 178: 1346-7(1968). (In Russian).

Quantum-mechanical calculations indicate that in a rare earth metal hexaboride crystal lattice, each metal atom should contribute 2 electrons to the bonds in the MeB$_6$ complex. Samsonov (Refractory compounds of the rare earth metals with nonmetals, Moscow, 1964) had indicated that the Me–B bond formation is feasible with the inclusion of less than 2 electrons from the metal (limit, 1.6 electrons). In divalent metals, this would cause the appearance of a not-too-wide energy gap. The nature of the physical properties of rare earth metal hexaborides is explained in this study, based on this purely theoretical model. The electrophysical characteristics of the hexaborides of Sm, Gd, Ce, Nd and La were measured in the 77 to 300°K range. Results agree with values on resistance (ρ) and thermal emf (α) found earlier. All the rare earth metal hexaborides with the exception of Sm have metallic properties. The negative inclination of ρ and the negative values at low temperatures indicate the semiconductivity of SmB$_6$, in which the Sm ion is divalent. EPR spectra helped establish that in EuB$_6$ the Eu ion is divalent, and in GdB$_6$ the Gd is trivalent. EuB$_6$ can also be identified as a compound with semiconducting properties. In Sm (4f^6 5d^0 6s^2) a major portion of the atoms has the f^7 configuration, but attraction of part of the 6s^2 electrons is needed to form this configuration, and this reduces the valency of Sm to below 2. According to ρ and α data in SmB$_6$, this valency is near 1.6, i.e., there is almost complete transfer of the Sm valency electrons to the complex with B, with formation of an energy gap and appearance of semiconducting properties. In the hexaborides of Nd, Pr, Ce, and La, the statistical weight of rare earth metal atoms with an f^0 configuration increases, making them predominantly trivalent, and in certain compounds the valency may be even higher. (ATD)

44269 EFFECT OF NEUTRON IRRADIATION ON THE MAGNETIC CHARACTERISTICS OF FERROMAGNETIC MATERIALS. Agayan, B. S.; Akopov, F. Kh.; Manvelidze, I. V.; Naskidashvili, I. A. (Inst. of Physics, Tbilisi, USSR). Fiz. Metal. Metalloved., 25: 760-2(1968). (In Russian).

The effect of neutron irradiation on the magnetic coercive force, residual magnetization, and magnetic susceptibility of Armco-iron and nickel has been investigated. Ring specimens of Armco iron and nickel were annealed for 5 hr at 900°C. Heat-treated specimens were placed in an IRT-2000 reactor and irradiated with an integral neutron flux of up to 1.4 × 10^{17} n/cm^2 for 100 hr. It was found that the coercive force of Armco iron began to increase at an integral flux of 10^{16} n/cm^2, attaining a value at 10^{17} n/cm^2 45% higher than the initial. The residual magnetization of Armco iron increased 22% under these conditions. The magnetic susceptibility of Armco iron decreased with increasing irradiation and at 1.4 × 10^{17} n/cm^2 was 24% lower than that before irradiation. The magnetic susceptibility of nickel also decreased, but under the same conditions it was only 16% lower than before irradiation. The obtained results show that the magnetic characteristics of Armco iron are affected by even small doses of neutron irradiation (10^{17} n/cm^2). This can be explained by the fact that even a comparatively low concentration of radiation defects induces local disorientation of magnetic moments of atoms. (ATD)

44270 HALL EFFECT IN YTTRIUM MONOCRYSTALS. Volkenshtein, N. V.; Galoshina, E. V. (Inst. of Metal Physics, Moscow). Fiz. Metal. Metalloved., 24: 1105-7(1967). (In Russian).

It is known that in uniaxial crystals of such metals as Zn, Cd, Co, and Ni the magnitude of the Hall effect depends not only on the crystallographic orientation but also on temperature; with decrease in temperature this anisotropy decreases. In this connection, the temperature dependence of the Hall effect was investigated in yttrium monocrystals ($\rho_{293°K}/\rho_{4.2°K} = 10.4$) at temperatures of from ~20°C (room temperature) to the temperature of liquid helium. Two specimen platelets were cut out from a single crystal of a macrocrystalline ingot: in one the hexagonal axis lay in the plane of the specimen and in the other, at right angles to that plane. In both specimens current was passed in the direction [1010]. The measurements were carried out with the aid of a KL-48 potentiometer and an M-17/3 galvanometer. The field dependence of the Hall emf was measured in fields of up to 15 kOe at four temperatures: room, liquid nitrogen, hydrogen and helium. The values of the Hall coefficient at from 20 to 290°K were obtained during measurements in a cryostat in the presence of a constant field of 10 kOe. Findings: at room temperature $R_\perp$ (the Hall coefficient in the specimen in which the field H is at right angles to the hexagonal axis c) amounts to -17.9 V-cm/A-gauss while $R_{||}$ (field H parallel to the hexagonal axis) amounts to -4.7×10^{-13} V-cm/A-gauss. $R_{||}$ changes insignificantly as the temperature decreases to 100°K, but below that temperature it sharply drops, whereas, by contrast, $R_\perp$ monotonically increases from 4.7 V-cm/A-gauss at room temperature to 9.8×10^{-13} V-cm/A-gauss at the temperature of liquid helium. Such a marked R(T) dependence observed for yttrium may be attributed to both the mechanism of the scattering of current carriers on the Hall effect and to the variation in the "effective" number of current carriers — a variation that is possible in the presence of a complex Fermi surface and small groups of the carriers. (Yttrium is a transition metal and in all likelihood has a complex Fermi surface and more than one type of current carrier.) (ATD)

44271 RESONANCE PROPERTIES OF CHERENKOV RADIATION AT LONGITUDINAL WAVES. Vitlina, R. Z.; Zhelnov,

B. L. (Inst. of Semiconductors, Novosibirsk, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 693-9(1968). (In Russian).

Radiation from an electron passing through a plate is considered. It is shown that in the presence of a transparency window in the frequency range where the spatial dispersion is essential, there are excited longitudinal Cherenkov waves with which an electron may interact. The quantum output of radiation is estimated. (auth)

44272 PARTITION OF THE AVERAGE ENERGY DEPOSITED IN GERMANIUM AS A FUNCTION OF INCIDENT NEUTRON ENERGY. Sattler, Allan R.; Vook, Frederick L. (Sandia Lab., N. Mex.). Phys. Rev., 173: 435-9(Sept. 10, 1968).

The average energy deposited in crystalline germanium per incident neutron has been calculated as a function of neutron energy. The calculations are for neutron energies below 4 MeV, where scattering events predominate and charged-particle production is minimal. A calculation at 14 MeV by Nichols is also included. As the incident neutron energy increases from 50 keV to 14 MeV, the average ionization energy deposited increases from $\sim 1 \times 10^{-12}$ to $\approx 1 \times 10^{-6}$ (erg/g) per (neutron/cm^2), and the energy available for displacements (nonionization) increases from $\approx 1 \times 10^{-10}$ to $\approx 3 \times 10^{-9}$ (erg/g) per (neutron/cm^2). The calculated neutron-energy dependence of the energy available for displacements agrees with the energy dependence of carrier-removal experiments in germanium performed with monoenergetic neutrons. Comparisons of these calculations are made with analogous ones for silicon. The energy deposited into atomic processes per carrier removed for $\sim 40-\Omega$ cm n-type germanium is $\approx 0.5 \times 10^{-9}$ erg/carrier, and the corresponding number is about a factor of 2 larger in the case of n-type silicon. (auth)

44273 EFFECTS SEEN IN THE PASSAGE OF POSITIVELY CHARGED IONS THROUGH SINGLE CRYSTALS. Holland, R. E.; Gemmell, D. S. (Argonne National Lab., Ill.). Phys. Rev., 173: 344-57(Sept. 10, 1968).

Some effects seen when swift, positively charged light ions are passed through various monocrystalline materials are reported. The main part of the work concerns blocking effects observed when protons in the energy range 3 to 12 MeV were passed through thin ($\sim$10 mg/cm^2) monocrystals of silicon. The energies and spatial distributions of the emergent particles were recorded both with photographic plates and with an automated scanning detector. In addition to the usual distribution of particles produced by Rutherford scattering, the spatial distributions are observed to include sharp lines corresponding to the planes of the target crystal. The observed widths of these lines are found to vary inversely as the square root of the energy of the incident ion. A calculation that traced the paths of ions through a hypothetical rigid lattice gave results qualitatively in agreement with observation. Photographic plates exposed to protons from the reaction ^{28}Si(d,p)^{29}Si occurring in a silicon crystal showed blocking phenomena similar to those observed with elastically scattered protons. In the angular region in which scattering is changing to blocking, the intensities of particles show a behavior that could be the result of wave phenomena. (auth)

44274 ^{127}I NUCLEAR QUADRUPOLE RESONANCE IN ANTIFERROMAGNETIC UI$_3$. Parks, S. I.; Moulton, W. G. (Florida State Univ., Tallahassee). Phys. Rev., 173: 333-7 (Sept. 10, 1968).

The ^{127}I nuclear quadrupole resonance (NQR) spectrum in antiferromagnetic UI$_3$ was studied in the temperature range 1.4 to 2.4°K in zero external field in a polycrystalline sample. A total of 32 lines were observed in the frequency range 6 to 156 MHz. A computer analysis of the spectrum showed that there were three different magnitudes of local magnetic fields at the iodine sites: 14.08, 17.33, and 17.44 kG. These three field magnitudes were assigned to specific iodine sites in the UI$_3$ crystal, and the directions were determined to within an eightfold ambiguity by analogy with single-crystal NQR results for the isomorphic compound NdBr$_3$. From these results the magnetic space group $P_c2_12_12$ is tentatively assigned. Analysis of the temperature dependence of the spectrum gives a sublattice magnetization curve that is unusually abrupt and is quite similar to that observed in UO$_2$. (auth)

44275 SOME PROPERTIES OF GERMANIUM ALLOYED WITH NEODYMIUM. Levinzon, D. I.; Sachkov, G. V.; Smirnov, Yu. M.; Shershel, V. A. Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 280-1 (1968). (In Russian).

The effect of 1×10^{14} to 8×10^{15} cm^{-3} concentrations of Nd in Ge single crystals on carrier mobility was studied to determine its possible correlation with the presence of residual impurities, particularly oxygen. Nd of 99.4% purity was alloyed with Ge of specific resistance at room temperature higher than 45 ohm · cm, and the life time of unbalanced carriers equaled 1500 μsec. The maximum solubility of Nd, 8×10^{15} cm^{-3} under conditions of one time ionization, exceeded the published value of 3×10^{15} cm^{-3}. The dependence of mobility on Nd concentration at 77 K showed a decrease in mobility compared with Sb alloyed single crystals of Ge. The effect was tentatively ascribed to formation of compounds with residual oxygen and this theory was confirmed by ir spectra of specimens containing added oxygen in the presence and absence of Nd. Oxygen is bonded to Nb by complexes which are partially separated as low density slags and remain partially in the melt, causing the noted decrease in mobility. The formation of low density products could be utilized for purifying Ge by Nd addition and this process is presently being studied. Neodymium or another rare earth element could be used as additions in Ge semiconductors to obtain a low donor level. (ATD)

44276 CRYSTALLINE STRUCTURE AND MAGNETIC PROPERTIES OF THE COMPOUND GdPd. Pierre, Jacques; Siaud, Etiennette (Laboratoire d'Electrostatique et de Physique du Metal, Grenoble, France). Compt. Rend., Ser. A and B, 266: 1483-5(June 17, 1968). (In French).

The compound GdPd crystallizes with an orthorhombic structure of the type CrB. A state of ferromagnetic ordering is established at 39.5 ± 1°K. (tr-auth)

44277 RADIATION ANNEALING OF PRIMARY γ DEFECTS IN dl-ALANINE AND TRIGLYCINE SULFATE MONOCRYSTALS. Shul'ga, S. Z.; Bartnovskii, O. A.; Solov'ev, A. V. (Kiev Inst. of Physics). Ukr. Fiz. Zh., 13: 995-9(June 1968). (In Russian).

Optical annealing was investigated in γ-irradiated α-alanine and triglycine sulfate single crystals by the ESR method at low temperatures (77°K). The characteristic changes were detected of the ESR spectra of the single crystals γ-irradiated at low temperatures. These changes may be explained by the presence of the photochemical reactions between both the stabilized free radicals and between the radiation-induced free radicals and dissolved molecular impurities in the parent lattice (α-alanine). (auth)

44278 SELECTION OF REFRACTORY OXIDES FOR REACTOR FUELS AT HIGH TEMPERATURE. Robert, G.; Besson, J.; Deportes, C. (Faculte des Sciences, Grenoble, France). Rev. Energ. Primaire, 2: 5-9(1966). (In French).

Electric properties of various solid electrolytes obtained by melting of ceramic oxides with anionic gap structure have been studied at high temperature (up to 1750°C). Total conductivity was studied by the "two points" method, and ionic conduction by the method of the two partial oxygen pressures. (auth)

Theoretical Physics

Refer also to abstracts 43918 and 44345.

44279 ENERGY TRANSFER BY MATERIAL PARTICLES AND RADIATION IN A GENERAL RELATIVISTIC GAS. Suhonen, Esko. Kgl. Dan. Vidensk. Selsk., Mat.-Fys. Medd., 36: 27(1968).

A general relativistic form of the energy transfer equation is developed for material particles interacting with a spherically symmetric and static medium. Using the relativistic expressions of the energy density and the pressure in the different statistics, the radial energy flow is obtained from the transfer equation for Maxwellian particles, bosons, and fermions as a diffusion approximation. The thermal conductivity of ionization electrons is derived for a medium consisting of only one kind of nuclei. The equations of the energy transfer by photons and neutrinos are obtained in the special case of massless energy carriers. The condition of no net energy flow is found to lead to Tolman's law of thermodynamical equilibrium. The mean absorption coefficient of material particles is introduced and an approximative method for the calculation of this coefficient is given analogously to the Rosseland mean opacity. (auth)

44280 DUALISM IN QUANTUM THEORY. Born, Max; Biem, Walter Phys. Today, 21: No. 8, 51-5(Aug. 1968).

The question of dualism in quantum theory is discussed in terms of Lande's approach, Einstein's derivation, Bose statistics, Duane's formulation, Schrödinger's opposition, singularities from a continuum, space and momentum pictures, and bosons and fermions. Replies by Lande to points raised in the article are included along with further comments by Born and Biem. (W.D.M.)

44281 METHOD OF MOMENTS IN THE COLLISION THEORY. Eu, B. C. (McGill Univ., Montreal). J. Chem. Phys., 48: 5611-22(June 15, 1968).

The scattering matrix elements for two-body collision problems are obtained in terms of reactance matrix elements which are in turn given in terms of solutions of moment problems. The reactance matrix elements obtained by this method are suitable for practical calculations. Nonsingular as well as optical potentials are used in this study and illustrative calculations are given. The phase shifts calculated with an attractive exponential potential by means of the first moment of symmetrized integral kernel gives a reasonable agreement with the exact phase shifts for the parameter chosen. General forms and computational prescriptions for a semiclassical optical phase shift and wavefunction are given. For an optical potential with a δ function as its imaginary part the first moment gives rigorous result. Optical phase shifts for this potential are calculated as a function of orbital angular momentum at a given kinetic energy. It is found that the imaginary part of the phase shift has a series of sharp spikes, which may render an explanation of the undulation at large angles of the differential elastic cross section of reactive systems. It is also shown that the optical phase shift obtained in this method reduces in high-energy limit to a form similar to that in the eikonal approximation. (auth)

44282 CORRELATION BETWEEN TIMES OF EMISSION AND ABSORPTION OF EXCHANGED PHOTON. Zon, B. A.; Shirokov, M. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 7: 1316-24(June 1968). (In Russian).

The Goldberger–Watson formalism for calculation of the time correlations in quantum-mechanical systems is applied to the concrete phenomenon. With a modification of the formalism, one is able to account for information on the states of the system in several intermediate moments (not only in one moment). The quantum electrodynamic effect of the exchange by an excitation between two atoms is calculated with the formula obtained by means of the perturbation theory. In the beginning the atom A is excited; there is a probability for the atom B to be excited until the time t be over. The intermediate information is that the time for the photon emission by the atom A is known. Such an experiment may be considered as a quantum-mechanical modification of the experimental measurement of the velocity of light. The noncausal effects arising in the calculation are of the same character as those discussed previously. In the cases when these effects are not substantial, the qualitative results are obtained that ought to be expected. The deviations from the exponential decay law at small times obtained in the auxiliary calculation are discussed. (auth)

44283 N-FERMION SYSTEM. Post, H. R. (London Univ.). Phys. Lett., 27A: 339(Aug. 12, 1968).

A model yielding a lower bound to the ground-state energy of an N-fermion system is given, and a general expression is derived giving a pessimistic estimate of the deviation of this lower bound from the exact value. (auth)

44284 GREEN FUNCTION OF AN ELECTRON INTERACTION WITH AN ELECTROMAGNETIC FIELD. Gontier, Yves; Trahin, Michel (CEN, Saclay, France. Service de Physique des Interactions Electroniques, Gif-sur-Yvette, France). Compt. Rend., Ser. A and B, 266: 1177-80(Apr. 29, 1968). (In French).

The utilization of the second quantization formalism makes it possible to show that the nonperturbed Green function is modified by terms expressing mechanisms of absorption followed by readmission of a field photon. (tr-auth)

44285 SOME EFFECTS CONNECTED WITH THE SPIN OF THE DIRAC ELECTRON BY THE FOLDY–WOUTHUYSEN METHOD. THEIR RATIOS WITH THE MAGNETODYNAMIC EFFECT. Conort, Alain (Institut Henri Poincare, Paris). Compt. Rend., Ser. A and B, 266: 1184-7(Apr. 29, 1968). (In French).

It has been shown in different ways that the force exercised by the electromagnetic field on a magnetic dipole is the Stern–Gerlach force completed by a new magnetodynamic force. It appeared necessary to know if a charged particle with spin $\frac{1}{2}$ has a behavior analogous to that of an orbital magnetic dipole (coulomb or ampere). The study shows that the response is positive in several particulars. (tr-auth)

44286 QUANTUM TRANSPORT THEORY IN STRONG MAGNETIC FIELDS. Budd, H. F. (Ecole Normale Superieure, Paris). Phys. Rev. Lett., 21: 425-6(Aug. 12, 1968).

A theory of transport in strong magnetic fields is presented which is not limited to linear response in the electric field. The steady-state occupation probabilities of the eigenstates of the crossed-field Hamiltonian are determined by a master equation and are shown to be independent of the absolute coupling constants to the scattering system, but dependent on the form of the interaction. A generalized orbit-jump formula is derived for the dissipative current. (auth)

44287 DESCRIPTION OF POLARIZATION IN CLASSICAL PHYSICS. Collett, Edward (Atmospheric Sciences Lab., Fort Monmouth, N. J.). Amer. J. Phys., 36: 713-25(Aug. 1968).

An alternate derivation of the Stokes polarization parameters is presented; the parameters are obtained from the elliptic equation of polarization rather than the plane wave equations. As a result of deriving the parameters in this manner, the relationship between the polarization ellipse and the Stokes parameters is clarified. The Stokes parameters for various states of polarized light are briefly reviewed. The remainder of this article is then devoted to obtaining the Stokes parameters for a number of important physical phenomena such as the classical Zeeman effect, synchrotron radiation, Thomson scattering, reflection of electromagnetic waves by dielectric surfaces, and wave propagation in a plasma. (auth)

44288 INITIATION OF THE GENERAL THEORY OF PARTICLE TRANSFER. Kourganoff, V. (Univ., Paris). pp 275-88 of Modern Astrophysics. Hack, M. New York, Gordon and Breach, 1967. (In French).

An introduction to a general theory for particle transfer for the study of neutron scattering and the transfer of gamma radiation is given. The purpose of this theory is for the study of macroscopic effects of interactions between moving particles such as neutrons and photons and particles of a fixed milieu such as nuclei, atoms, or ions. A model is presented in which is emphasized the physical significance of the principal equations by which this transfer is expressed. (J.F.P.)

44289 SYMMETRIES OF QUANTUM OSCILLATOR SYSTEMS. Abdullaev, A. A. (Physical Inst., Academy of Sciences, Dagestan, USSR). Yadern. Fiz., 7: 1339-45(June 1968). (In Russian).

Symmetries of quantum oscillator systems are investigated in presence of a pair interaction between linear oscillators. It is shown that in such systems there arises a nontrivial superposition of the unitary and the permutation symmetries of the system. A symmetry group of the radial motion of the spherical oscillator is also investigated. (auth)

44290 INTERACTIONS OF ELECTRONS IN THE FIELD OF A BACKGROUND MONOCHROMATIC ELECTROMAGNETIC WAVE: QUANTUM INTENSITY-DEPENDENT FREQUENCY SHIFT. Prakash, Hari; Chandra, Naresh (Univ. of Allahabad, India). J. Phys. Soc. Jap., 25: 615-16(Aug. 1968).

It is shown that in the interaction of electrons in an intense monochromatic electromagnetic wave which acts as a background field, there is a frequency shift which has a quantum-dependence on the intensity of the background field (i.e., the shift vanishes on putting $\hbar = 0$). This intensity-dependent frequency shift is different from that reported in the literature. (M.H.R.)

44291 BIRKHOFF AND VON NEUMANN'S INTERPRETATION OF QUANTUM MECHANICS. Popper, Karl R. (London Univ.). Nature (London), 219: 682-5(Aug. 17, 1968).

It is argued that Birkhoff and von Neumann's famous paper "The Logic of Quantum Mechanics" culminates in a proposal concerning probability calculus which clashes with each of a number of assumptions made by the authors. (auth) (UK)

44292 SOME PROPERTIES OF THE CONTACT BETWEEN THEORY AND EXPERIMENT. Benioff, Paul A. (Argonne National Lab., Ill.). J. Math. Phys. (N. Y.). 9: 514-24(Apr. 1968).

This paper uses the sample probability-space description to review, under general conditions, the measurement process whereby an empirical expectation value is obtained for comparison either with other values or with values calculated from a theory. The emphasis here is on some of the conditions which must be satisfied by general sequences of single measurements, about which an observer may have relatively little knowledge, in order that such sequences yield suitable expectation values. In particular, sequences are considered for which the requirements that the single measurements of the sequence be independent and made of the same physical quantity on ensembles of identically prepared systems are not necessarily satisfied. The differences between sequences which satisfy these requirements and those which do not are discussed in terms of the implications or meaning of the resultant expectation value as a point of contact between theory and experiment. (auth)

44293 VARIATIONAL PRINCIPLE FOR THE LANDAU EQUATION. Dover, Carl B. (Univ., Heidelberg). Z. Phys., 214: 422-6(1968).

The Landau equation describing the collective modes of an infinite many-fermion system is cast into a form which displays explicitly its structure as a homogeneous Fredholm equation of the second kind with nonsymmetric kernel. A variational principle appropiate to this equation is constructed by noting the analogy to the integral form of the Schrödinger equation. The Landau equation is also re-expressed in terms of two coupled equations with symmetric kernels. (auth)

44294 ELECTRON MOTION IN SPECIAL-TYPE ELECTROMAGNETIC FIELDS. Bagrov, V. G.; Bordovitsyn, V. A. Zh. Vychisl. Mat. i Mat. Fiz., 8: 691-5(May-June 1968). (In Russian).

The motion of a relativistic particle with a negative charge and zero spin in external electromagnetic fields is described by the Klein–Gordon equation and the motion of a fermion with spin $^1/_2$ by the Dirac equation. The charge in electric and magnetic orthogonal fields and particle motion in axial magnetic fields were analyzed. (R.V.J.)

44295 SIMULTANEOUS WIENER–HOPF EQUATIONS AND THEIR APPLICATION TO DIFFRACTION PROBLEMS IN ELECTROMAGNETIC THEORY. III. Igarashi, Akira (Electrotechnical Lab., Tokyo). J. Phys. Soc. Jap., 25: 607-15(Aug. 1968).

An infinite set of simultaneous Wierner–Hopf equations with the kernel which is a Laurent matrix and its application is discussed. Owing to the special form of the kernel, it can be shown that the Fourier series expansion method transforms the infinite set of simultaneous equations into a single one containing a parameter. On the basis of this result, a treatment is made of the radiation of electromagnetic waves of TM type from an infinite set of staggered, equally spaced, semi-infinite plates. (auth)

44296 PERTURBATION EXPANSION OF THE WAVE FUNCTION OF BOSON SYSTEMS. Rhodes, Edgar; Erdoes, Paul (Florida State Univ., Tallahassee). Helv. Phys. Acta, 41: 567-72(Aug. 15, 1968).

For applications, the Rayleigh–Schrödinger nondegenerate second-order perturbation expansion of a many-particle wave-function is explicitly presented. The wave-function represents an assembly of bosons in a perturbing potential. The potential, expressed in second-quantized form, is linear and bilinear in the boson operators and contains arbitrary operators which couple the bosons to other systems of particles. (auth)

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

44297 (UCLA-34-P-106-27) ANNUAL PROGRESS REPORT [ON PARTICLE PHYSICS]. (California Univ., Los Angeles. Dept. of Physics). June 1, 1968. Contract AT(11-1)-34. 41p. Dep. CFSTI.

Experimental work in progress on the $n + p \rightarrow \gamma + d$ and $\pi + p \rightarrow n + \gamma$ interactions is described, and completed work on various K decays is reviewed. Also reviewed are the operation and performance of the high-energy radiation detectors used. (J.F.P.)

44298 (UCR-34-P-107-68) ANNUAL REPORT [ON PARTICLE PHYSICS]. Barkas, W. H. (California Univ., Riverside). May 1968. Contract AT(11-1)-34. 24p. Dep. CFSTI.

Bubble chamber and emulsion work that has been carried on during the past year is described. Some work has been done on a total of eight programs as follows: three-pion decay of the K^+ meson, negative K meson interactions in emulsions, high-energy π^+p interactions, K^--p interactions, high-energy electromagnetic processes, high-energy $\bar{p}p$ scattering, inelastic π^+p scattering in the 1900 MeV resonance region, and formalism for partial wave analysis of the process $0^- + \frac{1}{2}^+ \rightarrow \frac{3}{2}^+ + 0^-$. New equipment was acquired with university resources; a total of $200,000 worth of bubble chamber scanning and measuring equipment is in use. (auth)

Electromagnetic

44299 (DESY-68/34) MEASUREMENT OF THE PHOTOPRODUCTION OF VERY ASYMMETRIC mu-PAIRS BY A RANGE ABSORBER METHOD. von Goeler, Eberhard; Joos, Peter (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). June 1968. 47p. Dep.

Some cross section calculations and other considerations for a possible measurement of very asymmetric muon pair production in carbon or hydrogen are presented. In this type of experiment only one member of the pair is observed. It carries off most of the photon energy and is emitted near the forward direction. A range absorber method for the detection of the muons is proposed. In this method a thick iron filter permits the passage of muons to a set of detectors. The energies of the muons are determined by their ranges in the material. Most other particles are absorbed by the iron filter before they reach the detectors. This experiment can be performed in the GeV range and will test quantum electrodynamics and/or muon electron symmetry with a sensitivity comparable to other pair production experiments. (auth)

44300 (LAL-1190) ELECTRONS, GAMMAS AND π^0, IN HEAVY LIQUID BUBBLE CHAMBERS. Morellet, D. (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire). Apr. 1968. 90p. Dep.

A basis is given for understanding how to measure, calculate, and use electronic trajectories and how to combine them in γ or π^0. Some related topics such as delta rays and radiation length determination are also briefly reviewed. (J.F.P.)

44301 1-BEV ELECTRON COMPTON SCATTERING NEAR 180^0. Gittelman, B. (Stanford Univ., Calif.); Barber, W. C.; Selove, W.; Tompkins, D.; Forman, F. Phys. Rev., 171: 1388-91(July 25, 1968). (NYO-2171-242).

Electrons and positrons near 0° lab were measured using bremsstrahlung photon spectra of 950- and 500-MeV maximum energy. The results are interpreted in terms of pair production and electron Compton scattering, the latter contributing primarily for center-of-mass scattering angles near 180°. The results are in agreement with the Klein-Nishina formula to within the accuracy of this experiment, which is about 10%. (auth)

44302 COMPARISON OF ELECTRON-PROTON AND POSITRON-PROTON ELASTIC SCATTERING AT FOUR-MOMENTUM TRANSFERS UP TO 5.0 $(GeV/c)^2$. Mar, Jerry (California Inst. of Tech., Pasadena); Barish, Barry C.; Pine, Jerome; Coward, David H.; DeStaebler, H.; Litt, J.; Minten, A.; Taylor, Richard E.; Breidenbach, M. Phys. Rev. Lett., 21: 482-4 (Aug. 12, 1968).

Measurements of the ratio (R) of positron-proton and electron-proton elastic-scattering cross sections were made, with the square of the four-momentum transfer (q^2) equal to 0.20, 0.69, 0.73, 1.54, 2.44, 3.27, 3.79, and 5.00 $(GeV/c)^2$. The measurements, after radiative corrections, are consistent with R = 1, with standard errors ranging from ±0.016 to ±0.123. The results give limits for the size of the two-photon effects. (auth)

44303 QUEST FOR FASTER-THAN-LIGHT PARTICLES. Alvaeger, Torsten; Kreisler, Michael N. (Princeton Univ., N. J.). Phys. Rev., 171: 1357-61(July 25, 1968).

An experimental search for the existence of particles that propagate with velocities that are always greater than the velocity of light in a vacuum has been performed. Subject to some assumptions regarding the behavior of such particles, it is found that the photoproduction cross section for such particles in lead is less than 3×10^{-30} cm^2. This upper limit does not depend strongly on the "rest mass" of the particles and is approximately the same for faster-than-light particles of any "rest mass." This search was sensitive to particles having charges between 0.1 and 2 electron charges. (auth)

44304 BREMSSTRAHLUNG IN THE ELECTRON-ELECTRON SCATTERING AT 2 x 160 MeV. Golubnichii, P. I.; Kushnirenko, E. A.; Onuchin, A. P.; Sidorov, V. A. (Inst. of Nuclear Physics, Novosibirsk, USSR). Yadern. Fiz., 7: 1240-5(June 1968). (In Russian).

Using the Novosibirsk set-up VEP-1 with colliding beams, the bremsstrahlung from the electron-electron scattering at 2 × 160 MeV was studied. The integral cross section of γ quanta production and the probabilities of emission in the electron scattering for small (~1.5°) and large (40-90°) angles was measured. Experimental data are in agreement with the results of quantum electrodynamic calculations. (auth)

44305 NEW GEOMAGNETIC LIMIT ON THE MASS OF THE PHOTON. Goldhaber, Alfred S.; Nieto, Michael Martin (State Univ. of New York, Stony Brook). Phys. Rev. Lett., 21: 567-9(Aug. 19, 1968).

On the basis of recent precise data on the earth's magnetic field, a new upper bound on the mass of the photon is obtained using a method that was originally proposed by Schrödinger. The limit is 1.15×10^{-10} cm^{-1} ≡ 2.3×10^{-15} eV ≡ 4.0×10^{-48} g, which is four orders of magnitude better than the best laboratory measurement, that of Plimpton and Lawton. (auth)

44306 POLARIZATION OF RECOIL PROTONS FROM NEUTRAL PION PHOTOPRODUCTION. Hayakawa, Satio; Horikawa, Naoaki; Kajikawa, Ryoichi; Kikuchi, Ken; Kobayakawa, Hisashi; Masaike, Akira; Mori, Kunikazu; Obayashi, Haruo; Ukai, Kumataro; Yoshida, Katsuhide (Nagoya Univ., Japan). J. Phys. Soc. Jap., 25: 307-18(Aug. 1968).

The polarization of the recoil proton in the process $\gamma + p \rightarrow p + \pi^0$ was measured for a pion angle of 120° in the cms system at photon energies 450, 500, 550, and 600 MeV. Magnetically analyzed protons were detected by a counter telescope consisting of three scintillation counters, which triggered the spark chamber system designed as a polarization analyzer. About 150 thousand spark chamber photographs were taken, and the tracks of protons quasi-elastically scattered by the carbon plates of the spark chamber and by a carbon block in its front were selected by manual scanning. Data from about 5000 photographs thus selected were processed by an electronic computer. Results obtained are: -0.07 ± 0.18 for 450 MeV, -0.25 ± 0.14 for 500 MeV, -0.38 ± 0.12 for 550 MeV and -0.43 ± 0.18 for 600 MeV. (auth)

44307 FORWARD PHOTOPRODUCTION OF VECTOR MESONS FROM HYDROGEN AT ENERGIES FROM 6.5 TO 17.8 GeV. Jones, W. G. (California Inst. of Tech., Pasadena); Kreinick, D.; Anderson, R.; Gustavson, D.; Johnson, J.; Ritson, D.; Murphy, F.; Gettner, M.; Weinstein, R. Phys. Rev. Lett., 21: 586-9(Aug. 19, 1968).

Measurements are reported of the differential cross sections of ρ^0- and φ-meson photoproduction on hydrogen for a range of the square of the four-momentum transfer t from -0.2 to -0.9 $(GeV/c)^2$ and a range of incident photon energies from 6.5 to 17.8 GeV. It is found that differential cross sections obtained for ρ^0 production are in good agreement with the vector-dominance model. (auth)

44308 HIGH-ENERGY PHOTOMESON PRODUCTION FROM HYDROGEN VIA THE "u CHANNEL." Anderson, R. (Stanford Linear Accelerator Center, Calif.); Gustavson, D.; Johnson, J.; Ritson, D.; Weinstein, R.; Jones, W. G.; Kreinick, D. Phys. Rev. Lett., 21: 479-81(Aug. 12, 1968).

The photoproduction process $\gamma + p \rightarrow \pi^+ + n$ was investigated over a wide range of energies and u values at the Stanford Linear Accelerator Center (SLAC) accelerator. A study was also made of $\gamma + p \rightarrow \pi^- + N^{*++}$ at one value of u, and $\gamma + p \rightarrow K^+ + \Lambda^0, \Sigma^0$ at one u value and three energies. The results for $d\sigma/du$ for the photoproduction of π^+ mesons from hydrogen are roughly $\alpha/2\pi$ of the corresponding cross sections for the elastic scattering of π^- mesons from hydrogen. The u dependence of our cross sections is not dominated by nucleon exchange as it is in the case of π^+p elastic scattering. (auth)

Weak

44309 STUDY OF KINEMATICALLY DETERMINED τ' DECAYS. Fung, S. Y.; Goldberg, R.; Meyer, S. L.; Plano, R. J.; Zinchenko, A. (Rutgers, The State Univ., New Brunswick, N. J.). Phys. Rev. Lett., 21: 485-7(Aug. 12, 1968).

A sample of 144 τ' decays was studied in which, for the first time, all the kinematical quantities are determined. The dependence of the matrix element on the neutral-pion energy has been measured and a linear extrapolation has been made to zero four-momentum. The result is consistent with the soft-pion prediction of current algebra. (auth)

44310 OBSERVATION OF TIME-DEPENDENT K_S AND K_L INTERFERENCE IN THE $\pi^+\pi^-$ DECAY CHANNEL FROM AN INITIAL K_0 STATE. Boehm, A.; Darriulat, P.; Grosso, C.; Kaftanov, V.; Kleinknecht, K.; Lynch, H. L.; Rubbia, C.; Ticho, H.; Tittel, K. (CERN, Geneva). Phys. Lett., 27B: 321-7(Aug. 5, 1968).

The phase φ_{+-} between the amplitudes $K_L \rightarrow \pi^+\pi^-$ and $K_S \rightarrow \pi^+\pi^-$ was measured. The result is 46° ± 15° for a $K_L - K_S$ mass difference $\Delta m/\hbar = (0.526 \pm 0.020) \times 10^{10}\ s^{-1}$, in good agreement with the "superweak model" of Wolfenstein which predicts $\varphi_{+-}^{SW} = 42.6° \pm 1.0°$. (auth)

44311 MEASUREMENT OF THE BRANCHING RATIO FOR THE DECAY $K^+ \rightarrow e^+ + \nu_e$. Botterill, D. R.; Brown, R. M.; Corbett, I. F.; (and others). (Nuclear Physics Lab., Oxford). Phys. Rev., 171: 1402-11(July 25, 1968).

The branching ratio for the K_{e2} decay, $K^+ \rightarrow e^+ + \nu_e$, was measured relative to the branching ratio for the $K_{\mu 2}$ decay, $K^+ \rightarrow \mu^+ + \nu_\mu$. The measurement was made at the Rutherford High Energy Laboratory using spark-chamber techniques. Positive kaons from a 700-MeV/c separated beam stopped and decayed in the beryllium plates of a small spark chamber. Charged decay products were momentum-analyzed with a spectrometer system consisting of a bending magnet and four sonic spark chambers. Electrons were identified by a threshold gas Čerenkov counter and by their range in a lead-aluminum spark chamber. Ten events were obtained in the K_{e2} region of the electron momentum spectrum. A background of 0.34 events was estimated in this region caused by the $K_{\mu 2}$ decay mode. A value for the ratio $R_K = \Gamma(K_{e2}^+)/\Gamma(K_{\mu 2}^+) =$ (1.9± [illegible]) $\times 10^{-5}$ was obtained. This is in good agreement with the prediction of the V – A weak-interaction theory assuming muon-electron universality: $R_K = 2.10 \times 10^{-5}$. The predicted value includes a radiative correction of – 18.5% resulting from virtual-photon processes. From the measurement of R_K an upper limit was obtained on the amount of pseudoscalar coupling contributing to the K_{e2} decay and was found to be $|f^P|/|f^A| < 2.2 \times 10^{-3}$, where f^P and f^A/m_K are the pseudoscalar and axial vector coupling constants. (auth)

44312 SCATTERING OF HIGH-ENERGY POSITIVE AND NEGATIVE MUONS ON ELECTRONS. Kirk, Thomas B. W.; Neddermeyer, Seth H. (Univ. of Washington, Seattle). Phys. Rev., 171: 1412-7(July 25, 1968).

A counter experiment on $\mu^\pm e$ scattering was performed in the muon beam at the Brookhaven AGS with particular emphasis on a possible asymmetry. Two strongly filtered beams of either sign were available, one peaked at 10.5 GeV/c, and the other at 5.5 GeV/c produced by further energy degradation in a uranium absorber. Electron energies were measured in terms of the light output produced by the cascade shower generated in a total absorption multilayer Pb scintillator counter. Two types of runs were made using the same apparatus with different event selection. In the first type all incident muons triggering the beam-defining hodoscope were counted, the effective target was distributed through the entire apparatus, and all pulses from the shower counter were measured and stored in a 400-channel pulse-height analyzer. In the second type the target volume was rather well defined, by a suitable pulse signature, to be the middle one of three water-Čerenkov counters placed in tandem in front of the shower detector. Results of the first type show that there is no asymmetry >±10% in the total electromagnetic energy loss spectrum from 0.1 to 6 GeV. Results of the second type, which have less good statistics, give the absolute μ-e scattering cross section to ±30% with no indication of an asymmetry. (auth)

44313 MEASUREMENT OF THE LIFETIME OF THE SHORT-LIVED NEUTRAL K MESON. Hill, D. G.; Robinson, D. K.; Sakitt, M.; Skjeggestad, O. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 171: 1418-20(July 25, 1968). (BNL-12330).

A measurement of the lifetime of the short-lived neutral K meson (K_S) was made based on the analysis of about 20,000 $K_S \rightarrow \pi^+ + \pi^-$ decays observed in the BNL 30-in. bubble chamber filled with deuterium. An extensive study has been made of possible systematic errors. The best estimate of the K_S mean life obtained is $\tau_S = (0.865 \pm 0.009) \times 10^{-10}$ sec. (auth)

44314 ON THE POSSIBILITIES OF THE EXPERIMENTAL INVESTIGATION OF THE $\bar{\nu}_e$-DEUTERON INTERACTION. Balysh, A.; Mikaelyan, L.; Frank, A. Yadern. Fiz., 7: 1237-9(June 1968). (In Russian).

A model of a detector to observe reactions $\bar{\nu}_e + d \rightarrow 2n + e^+$ and $\bar{\nu}_e + d \rightarrow \bar{\nu}_e' + n + p$ was constructed and tried. Experimental possibilities of detection of these reactions in practically available $\bar{\nu}_e$ beams from nuclear reactors, are discussed. (auth)

44315 PROBLEM OF MEASUREMENT OF THE NEUTRINO–ELECTRON SCATTERING. Bogatyrev, V. K. Yadern. Fiz., 7: 1234-6(June 1968). (In Russian).

An experiment on the measurement of the cross section of the antineutrino–electron scattering is proposed. To perform the experiment, an underground nuclear explosion is necessary. The measurements use a cheap detector of the weight of few dozens of tons. (auth)

44316 ISOTROPY IN π-μ DECAYS. Erota-Pessoa, E. (Istituto Nazionale Fisica Nucleare, Trieste, Italy). Notas Fis., Cent. Brasil. Pesqui. Fis., 13: No. 7, 149-64(1967).

An extensive analysis is made of all results on the angular distribution of π-μ decays in the nuclear emulsion stack used by Hulubei et al. Contrary to their previous analyses, which favored anisotropy for this distribution, it is shown that no strong indication of anisotropy subsists which is free from serious suspicion of residual uncorrected bias. The safe part of the scanning of that stack is in good agreement with isotropy. (auth)

44317 $K_2^0 \rightarrow 2\pi^0$ DECAY RATE. Bartlett, D. F.; Carnegie, R. K.; Fitch, V. L.; Goulianos, K.; Hutchinson, D. P.; Kamae, T.; Roth, R. F.; Russ, J. S.; Vernon, W. (Princeton Univ., N. J.). Phys. Rev. Lett., 21: 558-61(Aug. 19, 1968).

The ratio $|\eta_{00}|^2$ of the rate of decay $K_2^0 \rightarrow 2\pi^0$ to the decay rate $K_1^0 \rightarrow 2\pi^0$ was measured to be $|\eta_{00}|^2 = (-2 \pm 7) \times 10^{-6}$. (auth)

44318 TEST OF THE $\Delta S = \Delta Q$ RULE IN LEPTONIC DECAYS OF NEUTRAL K MESONS. Webber, Bryan R.; Solmitz, Frank T.; Crawford, Frank S. Jr.; Alston-Garnjost, Margaret (Univ. of California, Berkeley). Phys. Rev. Lett., 21: 498-502 (Aug. 12, 1968).

The time distributions of 242 leptonic decays of neutral K mesons produced in the reaction $K^- + p \rightarrow \bar{K}^0 + n$ were studied. For the $\Delta S = -\Delta Q$ parameter x is found $Re(x) = 0.22^{+0.07}_{-0.08}$, (Im(x) = -0.88 ± 0.08. (auth)

Strong (Baryon-Induced)

44319 (JINR-E1-3940) np INELASTIC INTERACTIONS AT ENERGIES FROM 2 TO 10 GeV. III. STUDY OF $N\pi\pi$ COMBINATIONS IN THE REACTION: $np \rightarrow np\pi^+\pi^+\pi^-\pi^-(m\pi^0)$. Moroz, V. I.; Nikitin, A. V.; Troyan, Yu. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1968. 9p. Dep.

There were 730 events of the type $np \rightarrow np\pi^+\pi^+\pi^-\pi^-(m\pi^0)$ originating in a propane bubble chamber in an exposure to neutrons with energies from 2 to 10 GeV selected. It is seen that the effective mass distributions of $p\,\pi^+\pi^+$, $p\,\pi^+\pi^-$ and $p\,\pi^-\pi^-$-combinations are satisfactorily explained by $N^{*++}_{(1236)}$ and $N^{*-}_{(1236)}$ productions. (auth)

44320 (NP-17578) DATA COMPILATION OF BARYON–BARYON INTERACTIONS. II. PROTON–NEUTRON COLLISIONS BETWEEN 1 AND 27 GeV/c. Alexander, G.; Benary, O.; Maor, U. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). [1968]. 23p. Dep.

A data compilation on neutron–proton interactions at 1 to 27.0 GeV/c obtained from p + d and n + p interactions using accelerator-generated beams is presented. These data were published during the period from January 1, 1954 to March 31, 1968. A list of references, curves showing the n + p total cross section in the isospin I = 0 state $[\sigma^T_{I=0} = 2\sigma^T_{np} - \sigma^T_{pp}]$, elastic and charge exchange cross sections, and polarization curves at various incoming momenta are included. (J.F.P.)

44321 PRODUCTION OF ISOBARS IN NUCLEAR INTERACTIONS OF PROTONS AT $\sim$20 GeV ENERGIES. Dremin, I. M.; Zhdanov, G. B.; Maksimenko, V. M.; Tret'yakova, M. I.; Chernyavskii, M. M. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 359-61(Mar. 1968). (In Russian).

Experimental data were obtained from a partial treatment of two photoemulsion stacks (of 600 μm thick Ilford K-5 emulsion) irradiated by 21.0-GeV protons in a 180 kOe magnetic field. Studies were made of the production processes of nucleon isobars (with 2 GeV mass) in quasi-nucleon interactions with a small number of secondary charged particles ($n \leq 4$) and respectively small inelasticity. The part played by the production of heavier isobars in the higher inelasticity interactions was also analyzed. Examination of tracks with a total length of 1 km revealed about 360 stars to which were added about 120 stars of the same type which were obtained by irradiation at 27 GeV. Due to the presence of a strong magnetic field it was possible to measure the momenta and charge of the particles and identify their origin. Tabulated data indicate that the probability of light isobar (1.24 GeV mass) production constitutes 15% of all interactions. (R.V.J.)

44322 DIFFRACTION PRODUCTION OF PARTICLES BY 20 TO 23-GeV PROTONS. Zhdanov, G. B.; Tret'yakova, M. I.; Chernyavskii, M. M. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz., 55: 170-8(July 1968). (In Russian).

The angular and momentum distributions of secondary particles in reactions of the type $p + \text{nucleus} \rightarrow p + \pi^+ + \pi^- + \text{nucleus}$ (in the absence of nuclear excitation) were measured in photographic emulsions exposed to a pulsed magnetic field (180 kOe). The distribution of longitudinal momenta transferred to the nucleus is obtained for 30 events interpreted as processes of coherent production of particles on the nuclei of the emulsion. The range of the given process in the photographic emulsion is estimated to be 47 m (±20%). (auth)

44323 SOME SINGULARITIES IN THE PRODUCTION OF π^0 MESONS IN NUCLEON INTERACTIONS AT ENERGIES EXCEEDING 10^{13} eV. Barazdei, L. T.; Kanevskaya, E. A.; Rykov, V. V.; Smorodin, Yu. A.; Solov'ev, M. V. (Inst. of Physics, Moscow. Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 368-71(Mar. 1968). (In Russian).

Experimental data are given on γ-quantum families produced by high-energy nucleon interactions with air atomic nuclei. The quanta were recorded in a device with 3.5 m^2 area at an elevation of 10 to 12 km (200 $g \cdot cm^{-2}$). Twenty four families of quanta with a total energy above 5 TeV produced no higher than 2 km above the installation were collected at a zenith angle of 0 to 41° during 120 hr of exposure. It was observed that the number of γ quanta with energies of $\geq 6 \times 10^{11}$ eV at a given total energy of ΣE_γ fluctuated from 3 to 12. The mean number of integrated quanta in the family of γ quanta was $6.5 + 3.0$. At energies exceeding 10 to 20 TeV the power-law spectrum has a slope of about 1.7. Calculations made of the $\Sigma E_\gamma > 10$ TeV quantum families showed a mean γ quantum distribution according to the energy $f = E_\gamma/\Sigma E_\gamma$, this distribution for $f \geq 0.1$ is well approximated by the exponential function of $n(>f) = Ae^{f/a}$. It was assumed that the constant magnitude of a reflects the emission of the higher energy pions by a system whose velocity rate is close to that of nucleons. (R.V.J.)

44324 INELASTIC PION–NUCLEON INTERACTION AT ENERGY OF 17 GeV. Anzon, Z. V.; Vinitskii, A. Kh.; Izbasarov, M.; Strel'tsov, I. S.; Takibaev, Zh. S.; Chasnikov, I. Ya.; Shakhova, Ts. I. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 7: 100-8 (1967). (In Russian).

Inelastic pion–nucleon interactions were studied using nuclear emulsions. There were 450 pion–nucleon interactions selected. All particles with incident angles of less than 8° to the emulsion surface were identified. The angular momentum characteristics of the secondary particles were analyzed. It was shown that the colliding particles after interaction try to maintain their initial direction of motion. This fact is inexplicable from the viewpoint of the statistical theory. At the same time there are interactions with high momentum transfer squared (Δ^2). In the distribution by Δ^2 there are differences for the pion–proton and pion–neutron interactions. The number of protons with $\Delta^2 < 0.8$ $(GeV)^2$ in π-p interactions is 50 ± 3% of the total number, whereas in π-n interactions the fractions of such protons is 17 ± 2% of the total. Calculations by the statistical criteria showed that the divergence is impossible to explain by the results of fluctuations. (J.S.R.)

44325 LARGE-ANGLE NEUTRON–PROTON ELASTIC SCATTERING FROM 3.0 TO 6.8 GeV/c. Cox, J. (Stanford Linear Accelerator Center, Calif.); Perl, M. L.; Kreisler, Michael N.; Longo, Michael J.; Powell III, S. T. Phys. Rev. Lett., 21: 641-4 (Aug. 26, 1968).

Extensive new data are presented on cross sections for neutron-proton elastic scattering from 3.0 to 6.8 GeV/c. At the higher momenta the cross sections are found to be nearly symmetric about 90° in the cm system for $|\cos\theta| \lesssim 0.3$. This symmetry implies that the contribution to the cross section from interference terms between the isospin-0 and isospin-1 amplitudes is small in this angular region. Other implications of the data are also discussed. (auth)

44326 DOUBLE EMISSION OF HEAVY FRAGMENTS ($Z \geq 4$) AT HIGH-ENERGY INTERACTIONS. Deka, G. C. (Cotton Coll., Gauhati, India); Bhuyan, H. R. Indian J. Pure Appl. Phys., 6: 251-2(May 1968).

Emission of heavy fragments ($Z \geq 4$) was studied in interactions initiated by 24- and 20-GeV/c protons separately in two nuclear emulsion stacks. In a large sample of stars, 315 heavy fragments were observed and analyzed. Their angular distribution was found to be nearly isotropic which is in agreement with the "evaporation" theory; 62 double emission events were analyzed and a strong angular correlation between the pairs was noticed. Higher excitation of the disintegration seems to facilitate the emission of these fragments. (auth)

44327 OBSERVATION OF $Y^{*+}(1385)K^+$ AND $N^{*++}(1236)\rho^0$ DECAYS OF A NUCLEON RESONANCE. Chinowsky, W. (Univ. of California, Berkeley); Condon, P.; Kinsey, R. R.; Klein, S.; Mandelkern, M.; Schmidt, P.; Schultz, J.; Martin, F.; Perl, M. L.; Tan, T. H. Phys. Rev., 171: 1421-8(July 25, 1968).

An analysis of p-p interactions at 6 BeV/c indicates the presence of a $T = \frac{3}{2}$ nucleon resonance with mass near 2.0 BeV/c^2, with decay modes $Y^{*+}(1385)K^+$, $N^{*++}(1236)\rho^0$, and $N^{*++}(1236)\pi^+\pi^-$. A peripheral production model for the reaction $pp \rightarrow nN^{*++}(1950)$ gives excellent agreement with the data, with a cross section for $N^{*++}(1950)$ production and subsequent decay into $Y^{*+}K^+$ of 13 ± 3 μb. (auth)

Strong (Meson-Induced)

Refer also to abstract 43324.

44328 (ORO-2504-127) INVESTIGATIONS ON THE PROPERTIES OF K MESONS AND HYPERONS AND RELATED TOPICS IN HIGH ENERGY PHYSICS. Progress Report, October 1, 1967–September 30, 1968. Technical Report No. 852. (Maryland Univ., College Park. Dept. of Physics and Astronomy). July 1968. Contract AT(40-1)-2504. 41p. Dep. CFSTI.

Research on the fundamental properties of elementary particles and their interactions is reviewed. Kaon interactions are studied primarily. The progress of the experimental bubble chamber and theoretical programs, the spark chamber-counter work, and the PEPR project status are reviewed. (J.F.P.)

44329 (UR-875-248) OBSERVATION OF MULTIPION RESONANCES AT 1630 AND 1720 MeV IN HIGH-ENERGY π^+p COLLISIONS. Baltay, C.; Kung, H. H.; Yeh, N.; Ferbel, T.; Slattery, P. F.; Rabin, M.; Kraybill, H. L. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). Aug. 1968. Contract AT(30-1)-875. 13p. (CONF-680809-13). Dep. CFSTI.

From 14th International Conference on High Energy Physics, Vienna, Austria.

The results of a hydrogen bubble chamber investigation of multipion production in $\pi^+ + p$ interactions at momenta of 6.95 and 8.5 GeV/c are presented. These data provide strong support for the existence of two isospin-1 resonances, a negative G-parity state at 1630 ± 10 MeV having a width of 70 ± 40 MeV and a positive G-parity state at 1720 ± 15 MeV having a width of 100 ± 35 MeV. These resonances are produced peripherally with observed production cross sections of approximately 40 and 60 μb, respectively. The results are based on an analysis of 6959 events of the reaction $\pi^+ + p \rightarrow p + 2\pi^+ + \pi^-$ and 5744 events of the reaction $\pi^+ + p \rightarrow p + 2\pi^+ + \pi^- + \pi^0$. (J.F.P.)

44330 SEARCH FOR A $2\pi^0$ RESONANCE NEAR 730 MeV IN π^+d INTERACTIONS. Smith, Gerald A.; Manning, Robert J. (Univ. of California, Berkeley). Phys. Rev., 171: 1399-1402 (July 25, 1968). (UCRL-17917(Rev.)).

In an analysis of 229,000 pictures of π^+ at incident momenta of 1.1 to 2.3 GeV/c in the deuterium-filled 72-in. bubble chamber, 8386 examples of the reaction $\pi^+d \rightarrow pp + \text{neutrals}$ were identified. An application of the impulse approximation gives 4965 events of the type $\pi^+n \rightarrow p + \text{neutrals}$. At a small momentum transfer (≤ 0.2 and 0.08 GeV/c^2) to the neutrals system, no direct evidence was found for an enhancement near the reported position of the ϵ^0, ≈730 MeV. A detailed subtraction of $3\pi^0$ and $N^*(1238)$ background based on cross sections from other experiments results in a $2\pi^0$ mass spectrum, which is found to be in agreement with the direct experimental results of Corbett et al. (in shape only) and with the prediction of Malamud and Schlein (in shape and magnitude). The latter is based on an analysis of the ρ-decay asymmetry. Consequently, the results are interpreted to be consistent with the existence of the ϵ^0, the parameters for which result from the analysis by Malamud and Schlein. (auth)

44331 COHERENT PRODUCTION OF $\pi^-\pi^0\pi^0$ FINAL STATES FROM NUCLEI AT 16 GeV/c. Daugeras, B. (Faculte des Sciences d'Orsay, France); Huson, R.; Lubatti, H. J.; (and others). Phys. Lett., 27B: 332-5(Aug. 5, 1968).

Coherent production of $\pi^-\pi^0\pi^0$ is observed in the interactions of 16 GeV/c π^- with nuclei. The main features of this final state are similar to those observed in the $\pi^+\pi^-\pi^-$ state, i.e., presence of a broad peak in the A_1 region which consists predominantly of $\pi\rho$ in a 1^+ or 2^- spin parity state. (auth)

44332 DIPS IN DIFFERENTIAL CROSS SECTIONS. Booth, Norman E. (Univ. of Chicago). Phys. Rev. Lett., 21: 465-8 (Aug. 12, 1968).

It is suggested that a dip at $t = -3$ $(GeV/c)^2$ which appears in both π^+p and π^-p scattering over a wide range of laboratory momentum is related to the dips in the 180-deg cross sections at 2.1 GeV/c. The energy dependence of the cross sections in the vicinity of the dip is consistent with a Regge trajectory for which $\alpha = -2$ at $t = -3$. (auth)

44333 DETERMINATION OF THE NEUTRON–NEUTRON SCATTERING LENGTH FROM THE REACTION $\pi^- + d \rightarrow 2n + \gamma$. Butler, P. G.; Cohen, N.; James, A. N.; Nicholson, J. P. (Univ., Liverpool). Phys. Rev. Lett., 21: 470-2(Aug. 12, 1968).

The photon energy spectrum from the reaction $\pi^- + d \rightarrow 2n + \gamma$ at zero energy was measured by a pair spectrometer using acoustic spark chambers to locate the pair-electron tracks. From the shape of the spectrum the neutron–neutron scattering length was determined to be $a_{nn} = 13.1^{-3.4}_{+2.4}$. The probability of existence of a bound state of two neutrons was calculated to be less than 5×10^{-9}. (auth)

44334 INVESTIGATION OF THE PROPERTIES OF SLOW π^+ MESONS PRODUCED IN THE π^-–Xe INTERACTIONS AT 9 GeV/c. Gadomskii, V.; Slovinskii, B.; Strugalskii, Z. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 7: 1246-50 (June 1968). (In Russian).

Angular and momentum distributions, as well as multiplicities of π^+ mesons with momentum from 50 up to 150 MeV/c produced in the π^-–Xe interactions at 9 GeV/c are investigated. (auth)

44335 EXISTENCE OF A Y_1^* RESONANCE AT 1616 MeV. Crennell, David J. (Brookhaven National Lab., Upton, N. Y.); Delaney, William C.; Flaminio, Enzo; (and others). Phys. Rev. Lett., 21: 648-50(Aug. 26, 1968).

An enhancement at 1616 ± 8 MeV is observed in the $\Lambda\pi^\pm$ mass spectrum from the reaction $K^-n \rightarrow \Lambda\pi^-\pi^-\pi^+$ at a beam momentum of 3.9 GeV/c. This is interpreted as a resonance of width 66 ± 16 MeV and isospin one. A similar enhancement is also observed in other final states. (auth)

44336 SOME ASPECTS OF π^--N INTERACTIONS AT 17.2 GeV/c. Kamal, A. A.; Rao, Y. V.; Rao, Rukmini (Osmania Univ., Hyderabad, India). Nucl. Phys., B6: 523-42(1968).

Results from the analysis of π^--N interactions at 17.2 GeV/c in photographic emulsions are presented. From the frequency of odd and even shower multiplicities, evidence is presented to support the conclusion of Davis et al. that the surface of heavy nuclei is rich in neutrons. Inelasticities for small and large shower multiplicities are deduced. Discrepancies in inelasticities obtained in emulsions and bubble chambers are attributed to the differences in the momentum selection criteria. It is concluded that the symmetry in angular distributions of pions in π-π system in small multiplicity events, is accidental. The frequency of K mesons is indirectly estimated from the energy balance, and is found to be consistent with direct observations, in the hydrogen bubble chamber, at similar energy. The frequency of neutral pions is deduced for various groups of shower multiplicities. In very large multiplicity events ($n_s \geq 8$), negligible numbers of π^0 are found to be produced. The transverse momentum (P_t) distribution for pions is found to be in agreement with Hagedorn's theory as well as with the formula of Cocconi et al. The P_t distribution for protons, on the other hand, is inconsistent with Hagedorn's theory. (auth)

44337 SEARCH FOR 1 = 2 HYPERONS AND STUDY OF RESONANCES IN K⁻d INTERACTIONS. Barbaro-Galtieri, A. (Univ. of California, Berkeley); Matison, M. J.; Rittenberg, A.; Chadwick, G. B.; Guiragossian, Z. G. T.; Pickup, E. Phys. Rev. Lett., 21: 573-6(Aug. 19, 1968).

A search was made for isospin-2 hyperon resonances produced in K^-n interactions at 2.11 and 2.65 GeV/c which decay into $\Sigma^-\pi^-$ or $\Sigma^-\pi^-\pi^0$. No evidence was found for any such state with $M \leq 2300$ MeV, and a cross-section upper limit of 30 μb was obtained, with 99% confidence level. (auth)

44338 MASS DEPENDENCE OF THE SMALL ANGLE DIFFERENTIAL CROSS SECTION FOR HIGH ENERGY INTERACTIONS. Bartsch, J. (Technische Hochschule, Aachen); Deutschmann, M.; Keppel, E.; (and others). Phys. Lett., 27B: 336-40(Aug. 5, 1968).

A study of differential cross sections for 8 GeV/c π^+p and 10 GeV/c K^-p reactions, treated as two-body processes, has indicated that as the mass M of one of the "bodies" varies, the small angle differential cross section is described by $d\sigma/dt' = K \exp(-At')$ for all values of M, whether corresponding to a resonance or to a "background" region. In general, similar values of A are obtained for a resonance region and for its neighbouring mass bands. In most channels, as M increases, the angular distribution becomes broader, namely, $A \propto M^{-\alpha}$, with $0 < \alpha < 2$. (auth)

Particle Interactions and Properties (Theoretical)

General

44339 (ANL-Trans-650) SOME UNUSUAL PROCESSES IN THE FIELD OF HIGH ENERGY PHYSICS. Landsberg, L. G. (Institut Fiziki Vysokikh Energii, Serpukhov (USSR)). Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from report IFVE-SEF-68-1-K. 10p. Dep. CFSTI.

Several fairly arbitrary assumptions on some new processes which were not previously observed and which are either forbidden or very strongly suppressed are made. Only such processes for which experimental approaches can be indicated for the verification of the hypothesis made are considered. The mechanism of high momentum transmission, nonleptonic weak processes with high transmitted momenta, the nonpreservation of strangeness, the possible existence of processes with a nonpreservation of baryon charge, other phenomena with large transmitted momenta, and the search for heavy particles in two-body reactions are discussed. (J.F.P.)

44340 (IC-68/61) ON SPECTRAL FUNCTIONS SUM RULES. Bollini, C. G.; Giambiagi, J. J. (International Centre for Theoretical Physics, Trieste (Italy)). July 1968. 11p. Dep.

Sum rules for the spectral functions of vector and axial fields are obtained from hypotheses on the behavior of vacuum values of the commutators on the cone. The consequences of vector dominance are examined. A discussion is given on the relation between our hypothesis and that of the equality of the unrenormalized masses and coupling constants. The sources of the fields are taken to be the weak vector and axial vector currents. (auth)

44341 (UCRL-18235) PHYSICS SEMIANNUAL REPORT, NOVEMBER 1967–APRIL 1968. (California Univ., Berkeley. Lawrence Radiation Lab.). May 1968. Contract W-7405-eng-48. 163p. Dep. CFSTI.

A report on research on theoretical and experimental high-energy physics at the Lawrence Radiation Laboratory is presented. In addition to particle interactions and decays, health physics, computing and data handling, and accelerator operation and development are covered. (J.F.P.)

44342 MASS-SPLITTING THEOREM FOR GENERAL DEFINITIONS OF MASS. Boehm, A.; O'Raifeartaigh, L. (Syracuse Univ., N. Y.). Phys. Rev., 171: 1698-1701(July 25, 1968).

Some previous theorems on mass splitting are considered for the case in which there is no mass gap. It is shown that, for a very wide class of definitions of particle masses, including their definitions as eigenvalues (isolated or nonisolated) of the mass operator, any Lie group containing the Poincaré group cannot contain a conventional semisimple spectrum-generating group such as SU(3) or SL(3,C). (auth)

44343 COMPOSITE PARTICLES AND THE PERTURBATION THEORY IN THE RELATIVISTIC FIELD THEORY. Braun, M. A. (Leningrad State Univ.). Yadern. Fiz., 7: 1306-15(June 1968). (In Russian).

It is shown that in the relativistic theory of scalar particles bounded into a composite particle, introducing a separate field for the composite particle one can exclude singularities on the coupling constants due to the composite particle. So the perturbation expansion becomes possible. As a result, a nonlinear equation of the bootstrap type for the composite particle form factor arises in a natural way. Parameters of the composite particle are fixed by the relations $Z_1 = Z = 0$. A variational relation for finding the form factor and the parameters of the composite particle is presented. (auth)

44344 COSMOLOGICAL CONSTANT AND THE THEORY OF ELEMENTARY PARTICLES. Zel'dovich, Ya. B. (Inst. of Applied Mathematics, Moscow). Usp. Fiz. Nauk, 95: 209-30 (May 1968). (In Russian).

Recent studies on the evolutionary model of the universe within the framework of the λ model have been stimulated by new observations concerning quasars and quasags (quasar galaxies). The λ model refers to the solution of the equation of the expanding universe, assuming that the cosmological constant $\lambda \neq 0$. It was found that the correlation between the brightness and the red shift cannot be fitted into the simple theories which do not involve the cosmological constant and do not stipulate the evolution of quasars. The predominant value of $z = 1.95$ for the red shift seems to support the λ model; however, this viewpoint is not any more generally accepted. The first correlations of λ with the theory of elementary particles resulted in the paradoxical finding that the energy of vacuum is infinite, the particles representing the excitation of the system. The possible solutions of the λ model are examined, considering a closed, spheric universe consisting of interacting particles at rest. The solutions lead to different results, including an unstable stationary state with respect to small excitations, leaving the universe homogeneous and isotropic, and another solution leading to a very small but not quite zero rate of expansion. It is shown that the field theory with relativistic invariance does not require that the energy of the vacuum be zero, but leads to a specific cosmological constant. The calculation of the value of λ is examined. (Review article, 29 references). (TTT)

44345 POSITION OPERATORS AND LOCALIZABILITY OF QUANTUM SYSTEMS DESCRIBED BY FINITE- AND INFINITE-DIMENSIONAL WAVE EQUATIONS. Barut, A. O.; Malin, S. (Univ. of Colorado, Boulder). Rev. Mod. Phys., 40: 632-51 (July 1968).

The principles of quantum mechanics impose certain restrictions on acceptable position operators. The probability density as derived from the position operator should agree with the fourth component of the current vector. The various relativistic wave equations are re-examined from the point of view of this consistency test. These and the group theoretical considerations lead to the conclusion that only a Dirac particle can be considered to be elementary. The position operator of the infinite-dimensional theories is investigated and the advantages of theories using the unitary representations of the Lorentz group are discussed. (auth)

44346 GEOMETRIC INTERPRETATION OF PARAMETRIZED DYNAMICS. Oliveira, Colber G. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Cent. Brasil. Pesqui. Fis., 13: No. 11, 231-57(1968).

The problem of determination of invariant dynamical functions, that is, functions of the dynamical variables, and also of the corresponding velocities, which possess a well-defined value when a coordinate transformation is carried out is treated. The method used for the determination of those invariant dynamical functions in the Hamiltonian representation is an extension for the classical dynamics of a method used previously in general relativity. The classical commutator algebra for those invariant dynamical functions is given. The equivalence of this commutator algebra with the Dirac method of introducing a new bracket for showing the presence of second class variables is demonstrated directly. (J.F.P.)

44347 RENORMALIZATION AND COMPOSITE EFFECTS IN THE LEE MODEL. Broido, Michael M. (Univ. of Kent, Canterbury, Eng.). J. Math. Phys. (N. Y.), 9: 510-14(Apr. 1968).

The version of the Lee model with relativistic kinematics is considered. The mass renormalization of the V particle, described in purely field-theoretic terms, is a nonlocal effect. The composite limit of the model is discussed. The natural choice of composite field is nonlocal in the elementary constituents. In the composite limit, Z_1 does not vanish. The Hilbert-space formalism of the composite theory is not equivalent to that of an $N-\theta$ theory with a four-particle interaction. All these results are cutoff independent. (auth)

44348 INTERACTION OF ELEMENTARY PARTICLES IN EIGHT-DIMENSIONAL SPACE. Duong Van Phi (Moscow State Univ. Univ. of Hanoi, Vietnam). Compt. Rend., Ser. A and B, 266: 1545-8(June 24, 1968). (In French).

A formulation of interaction theory in eight-dimensional space is constituted by the unification of ordinary and internal space–time. The integrations following the boundaries for the calculation of the effects, are carried out in the complex planes of the internal energies. The values of the matrix elements corresponding to the Feynman diagrams are finite. (tr-auth)

44349 ANALYTIC PROPERTIES OF A CLASS OF NONLOCAL INTERACTIONS. I. Gutkowski, D.; Scalia, A. (Univ., Catania, Italy. INFN, Catania, Italy). J. Math. Phys. (N. Y.), 9: 588-92 (Apr. 1968).

The analytic properties of the functions $S_l(k)$ for a class of nonlocal interactions are studied in the complex k (wave number) plane, for physical angular momenta. The results are compared with those of the local interactions. Two specific examples are discussed. (auth)

44350 COUPLING OF THE SPACELIKE AND TIMELIKE WAVE FUNCTIONS AT INFINITE MOMENTUM. Chang, Shau-jin; O'Raifeartaigh, L. (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., 171: 1587-90(July 25, 1968).

It is shown, using the E(2) basis for the unitary representations of SL(2,C), that the spacelike and timelike solutions to the Abers–Grodsky–Norton wave equation do not decouple at infinite momentum. It is concluded that this equation cannot be used to saturate the (isospin-factored) algebra of currents. (auth)

Electromagnetic

Refer also to abstracts 44384 and 44406.

44351 (ANL-Trans-649) PHOTOPRODUCTION OF THE W-MESON PAIRS. Kompaneets, V. G.; Folomeshkin, V. N. (Institut Fiziki Vysokikh Energii, Serpukhov (USSR)). Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from report IFVE-STF-67-66-K. 9p. Dep. CFSTI.

The analytical expression of the cross section for the W-meson pair photoproduction is obtained. The cross section is given in the form of the double integral in the invariant variables. The analysis of the threshold and asymptotic behaviors of the cross section is given. The numeral computation of the cross section is made for the masses 2, 2.5, and 3 GeV. (auth)

44352 (DESY-68/35) ANALYSIS OF SINGLE π^- AND π^+ PHOTOPRODUCTION ON DEUTERIUM AT HIGH ENERGIES AND LOW MOMENTUM TRANSFERS. Schilling, K. (Hamburg Univ. (West Germany). II. Institut fuer Experimentalphysik). June 1968. 14p. Dep.

Using the impulse approximation and accounting for the complete spin–isospin structure of the deuteron, it is shown that the photoproduction of single charged pions on the deuteron is suppressed by a factor of about $1 - \frac{1}{2} S(q)$ (S,q denote the deuteron form factor and the momentum transfer to the pion) with respect to the photoproduction on the free nucleon. For π^+ photoproduction the Glauber correction is estimated to be less than 12 per cent. (auth)

44353 (LNF-68/26) INFRARED RADIATIVE CORRECTIONS FOR RESONANT PROCESSES. Note No. 398. Pancheri, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). May 14, 1968. 10p. Dep.

A semiclassical treatment of the infrared radiative corrections for resonant processes is given, and the Bond factor which characterized it is defined. A generalization of this first approximation result is proposed to cover higher powers. The purpose of this generalization is to free the treatment of resonant states from the limitations of perturbation theory. These results are confirmed in lowest order perturbation theory, and the explicit form of the infrared correction factor is given. (J.F.P.)

44354 APPLICATION OF THE OPTICAL THEOREM FOR QUASI-ELASTIC SCATTERING TO THE PHOTOPRODUCTION OF VECTOR MESONS. Knies, G. (Deutsches Elektronen-Synchrotron, Hamburg, Ger.). Phys. Lett., 27B: 288-90(Aug. 5, 1968).

Some consequences of the unitarity of the S-matrix to inelastic diffraction scattering processes are investigated. The application to the photoproduction of vector mesons leads to model independent lower limits on the total cross section for the production of hadrons by photons. (auth)

44355 DETERMINATION OF THE PION AND CONSPIRATOR RESIDUES AND TRAJECTORIES IN π^+ PHOTOPRODUCTION FROM CONTINUOUS MOMENT SUM RULES. DiVecchia, P. (CNEN, Frascati, Italy); Drago, F.; Fontan, C. Ferro; Odorico, R.; Paciello, M. L. Phys. Lett., 27B: 296-9(Aug. 5, 1968).

Using continuous moment sum rules clear evidence is obtained for the pion conspiracy. The pion and conspirator residues and trajectories are found, which reproduce with accuracy the forward peak in the high-energy differential cross section. (auth)

44356 KINEMATICAL SINGULARITIES AND ZEROS FOR THE REACTION $\gamma N \rightarrow VN$. Gotsman, E (Tel-Aviv Univ., Israel); Maor, U. Phys. Rev., 171: 1495-1502(July 25, 1968).

Kinematical parametrizations for photon-induced reactions are discussed in detail, with special emphasis on photoproduction of vector mesons. It is shown that the fact that the photon is massless introduces additional singularities in the crossing matrix. A method for extracting these singularities is discussed. "Conspiring" and "evasive" solutions of the constraint equations, at the thresholds and pseudothresholds, of the process $\gamma + V \rightarrow \overline{N}N$ for both natural and unnatural parity-exchange systems are formulated. Kinematic factors obtained from the crossing matrix are compared with those obtained from a field-theoretic perturbative calculation for the exchange of a tensor meson. Examples are given that stress the inherent difficulties in correlating factorization, crossing, and the field-theory approach for one-particle-exchange theories. (auth)

44357 QUASI-ELASTIC ELECTRON–DEUTERON SCATTERING AND THE STRUCTURE OF NEUTRON. Kobiashvili, M. Ya. (Tbilisi State Univ., USSR). Yadern. Fiz., 7: 1224-7(June 1968). (In Russian).

Quasi-elastic electron–deuteron scattering is considered. In the calculation of the scattering cross section the gradient term in the Hamiltonian of the electron–deuteron interaction is taken into account. The influence of this term on the form factors G_{M_n} and $G_{E_n}{}^2$ is analyzed. It is shown that the account of the gradient term diminishes the values of the form factors. (auth)

44358 CONSEQUENCES OF THE MODIFIED HYPOTHESIS OF PARTIALLY CONSERVED AXIAL-VECTOR CURRENT IN PHOTOPION PRODUCTION. Tapper, M. L. (Goddard Space Flight Center, Greenbelt, Md.). Phys. Rev., 171: 1561-5(July 25, 1968).

The photopion production process $\gamma + N \rightarrow N + \pi$ is studied in connection with the hypothesis of partially conserved axial-vector current, which is suitably generalized to deal with electromagnetic interactions. Some interesting relations are derived between the nucleon magnetic moments and certain analytically continued isotopic-spin components of the photopion amplitude. It is found that one of these relations contains an amplitude which is related to an electromagnetic transition involving only the isoscalar part of the photon. This amplitude is calculated from the ρ-dominance model in the crossed photoproduction channel $\gamma + \pi \rightarrow N + \overline{N}$. With this model, the ρ-π-γ vertex is calculated in terms of the ρ-γ vertex, the renormalized π-N coupling constant, and the ratio of isoscalar and isovector nucleon magnetic moments. The present analysis gives a numerical value which is considerably smaller than those estimated previously by independent methods. (auth)

44359 MULTIPLE SOFT-PION PRODUCTION. Kamal, A. N. (Univ. of Alberta, Edmonton). Phys. Rev., 171: 1556-61(July 25, 1968).

The theory of multiple pion production based on the hypothesis of a partially conserved axial-vector current and current commutation relations is considered. Applications to the photoproduction of a single pion and pion pairs are discussed. (auth)

44360 ρ^+ PHOTOPRODUCTION AND π^+ PRODUCTION VIA ρ^+ REGGE-TRAJECTORY EXCHANGE. Picciotto, Charles (Univ. of California, Santa Barbara). Phys. Rev., 171: 1648-52 (July 25, 1968).

The problem of ρ^+ photoproduction off nucleons is examined with a ρ^+ Regge-trajectory-exchange model. The residues are found by comparison with the elementary-particle exchange model; thus the cross sections are in the terms of the ρ anomalous magnetic moment μv. The problem of ρ decay ($\rho^+ \rightarrow \pi^+ + \pi^0$) is also considered and the cross section is obtained for π^+ production. (auth)

44361 INCOHERENT-SCATTERING FUNCTION, TOTAL PAIR-PRODUCTION CROSS SECTION, AND PAIR-PRODUCTION LENGTH FOR HELIUM. Knasel, T. M. (Harvard Univ., Cambridge, Mass.). Contract AT(30-1)-2752. Phys. Rev., 171: 1643-7(July 25, 1968). (HUX–2572–32).

A formula for the incoherent-scattering function using either the correlated or the uncorrelated wave-function model of atomic helium is presented. With this the total triplet-production cross section is calculated, and thus the total pair-production cross section is evaluated (triplet + coherent pair). The pair-production length of helium is calculated to be 963.64 ± 1.5 cm for saturated liquid helium at 4.2°K. The pair-production length is defined as $l_{He} = A/N_0\sigma_{He}\rho_{He}$. The systematic uncertainty of about ±0.15% comes from the choice of screening functions. This is a factor of 10 more accurate than the known pair-production lengths of any other element. It is suggested that this increased accuracy for the pair-production length of helium may find application as a standard in experimental measurements of absolute cross sections for high-photon-energy induced reactions. (auth)

44362 FORM FACTORS AND ELECTROMAGNETIC MASSES. Yan, Tung-mow (Harvard Univ., Cambridge, Mass.). Phys. Rev., 171: 1613-9(July 25, 1968).

The π and ρ electromagnetic masses are calculated within the framework of chiral dynamics, including a ρ-γ form factor. "Anomalous-magnetic-moment"-type couplings of $\rho\pi\pi$ and $A_1\rho\pi$ are included, but it is found that their contribution to δm_π is very small. The dependence of the results on the form factor is discussed. (auth)

44363 INELASTIC CONTRIBUTION TO THE p–n MASS DIFFERENCE IN COTTINGHAM'S FORMULA. Muta, Taizo (Univ. of Sussex, Brighton, Eng.). Phys. Rev., 171: 1661-5(July 25, 1968).

The inelastic contribution to the p–n mass difference coming from some low-lying nucleon resonances is calculated by using Cottingham's expression for the electromagnetic self-energy of the nucleons. The contribution of the Roper resonance was estimated numerically, and is found to be too small to reverse the wrong sign of the elastic contribution. This result suggests the importance of the high-energy diffraction region in the inelastic contribution rather than the low-energy resonance region. (auth)

44364 COMPTON EFFECT ON NUCLEON AT LOW ENERGY. Shekhter, V. M. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 7: 1272-89(June 1968). (In Russian).

A simple and covariant method to derive the low-energy theorem is proposed that is based on the four kinematic relations for the invariants of the Compton amplitude. Coefficients at higher powers of cos θ are determined in the next order in the photon frequency. Unknown remain 6 coefficients that stand at the terms independent of the angle or at those linear in cos θ. One of them is expressed in terms of the polarizability at zero frequency, of the electric radius and of the nucleon anomalous magnetic moment. Comparison with the experimental data by Goldansky et al., shows that the electric polarizability of proton is $(5 \pm 2) \cdot 10^{-43}$ cm^3. The low-energy theorem for the scattering of vector mesons with zero mass exists also when the gauge invariance of the amplitude is absent. It allows one to find the low-frequency limit for the scattering amplitude of isoscalar or isovector photons. (auth)

44365 PION CONSPIRACY AND PION RESIDUE FROM THE FINITE-ENERGY PHOTOPRODUCTION SUM RULE. Roy, D. P.; Chu, Shu-yuan (Univ. of California, Riverside). Phys. Rev., 171: 1762-3(July 25, 1968).

The pion residue is obtained as an integral over the relevant photoproduction amplitude following the usual prescription of the finite-energy sum rule. The latter, studied as a function of t, reveals the following interesting features of the pion residue. It is nonzero at t = 0 (thus showing pion conspiracy), but vanishes around $-1.5\mu^2$, as required by high-energy data. The magnitude of the residue at t = 0 also agrees extremely well with that obtained from the high-energy forward photoproduction cross section. (auth)

44366 EMISSION OF LOW-ENERGY PHOTONS IN SCATTERING AND DECAY PROCESSES AND A POSSIBLE METHOD FOR DETERMINING ELECTROMAGNETIC PROPERTIES OF SHORT-LIVED STATES. Barshay, Saul; Yao, Tsu (Rutgers-The State Univ., New Brunswick, N. J.). Phys. Rev., 171: 1708-15(July 25, 1968).

It is shown by explicit calculation of an example that, in certain realizable physical situations, the leading terms in the spectrum of low-energy photons (terms of order 1/k and 1) accompanying a two-body scattering process depend explicitly upon the electromagnetic properties of an intermediate state in the nonradiative scattering process. The situation involves scattering at an initial energy equal to that of an intermediate resonant state with the emission of photons which, although at low energy compared to the excitation energy of the resonant state (or to the separation energy to a neighboring resonance), is significantly more energetic than the width of the resonant state (and the uncertainty in the initial energy). Only when the photon spectrum is studied for energies significantly less than the width of the resonant state is the content of a theorem noted by Low regained, namely, that as a consequence of electric charge conservation, the leading terms are determined entirely by the electromagnetic properties of the external particles and by the on-mass-shell nonradiative scattering amplitude. The condition that the leading terms give a reasonable approximation to the soft-photon spectrum is not sufficient to ensure that these terms are given by the Low limit. In the above situation these terms can be calculated as functions of reasonably well-defined parameters, such as the magnetic moment of a narrow resonance; and measurement of the soft-photon spectrum can, in principle, determine these parameters. Examples of radiative resonant scattering in nuclear physics are discussed with specific numerical estimates. (auth)

44367 POSSIBLE ENHANCEMENT OF TWO-PHOTON-EXCHANGE EFFECTS IN LARGE-MOMENTUM-TRANSFER ELECTRON–PROTON SCATTERING. Harte, John (Univ. of California, Berkeley). Phys. Rev., 171: 1832-3(July 25, 1968). (UCRL-18083).

An estimate is made of the two-photon-exchange contribution to elastic electron-proton scattering. The dependence of the $NN\gamma$ vertex function on the invariant momentum-squared of each leg is assumed to be given by a definite form recently derived in a crossing-symmetric bootstrap model. The two-photon effects turn out to be surprisingly large at large momentum transfer; recent form-factor measurements are consistent with the results of this calculation, but a decisive test of the theory awaits e^+p scattering at $t \approx -10$ $(\text{BeV}/c)^2$. (auth)

44368 DETERMINATION OF THE ELECTROMAGNETIC COUPLINGS OF THE ρ AND A_1 MESONS. De Baenst, P.; Pestieau, J. (Univ. de Louvain, Heverlee, Belgium). Phys. Rev., 171: 1805-8(July 25, 1968).

Using unsubtracted dispersion relations in the pole-dominance approximation and electromagnetic current conservation, the electromagnetic form factors are determined at $t = 0$ of the ρ and A_1 mesons. In addition, some general properties of the radiative leptonic decays of vector and axial-vector mesons are discussed. (auth)

44369 ELECTROMAGNETIC TWO-BODY PROBLEM FOR PARTICLES WITH SPIN. Schild, A. (Univ. of Texas, Austin); Schlosser, J. A. J. Math. Phys. (N.Y.), 9: 913-15(June 1968).

A two-body system is considered for classical particles with charge, spin, and magnetic moment. The particles move in circular orbits, with spins orthogonal to the orbital plane, and they interact through time-symmetric electromagnetic fields. Rigorous relativistic equations of motion and rigorous expressions for the total energy and angular momentum of the system, including contributions from the field, are obtained. (auth)

44370 OPTICAL-MODEL ANALYSIS OF PION–NUCLEUS SCATTERING. II. PION FORM FACTOR. Auerbach, E. H. (Brookhaven National Lab., Upton, N. Y.); Fleming, D. M.; Sternheim, M. M. Phys. Rev., 171: 1781-5(July 25, 1968). (BNL-12309).

The sensitivity of elastic $\pi^{\pm}$-α scattering to the pion form factor is calculated, using the velocity-dependent Kisslinger optical model. At 60 MeV an accuracy of 0.01 mb/sr should give the pion rms charge radius r_π to a few tenths of a fermi; additional form-factor details are not readily measurable. The use of the deuteron and other targets is examined. (auth)

44371 HIGH-ENERGY BREMSSTRAHLUNG AND ELECTRON PAIR PRODUCTION IN THIN CRYSTALS. Palazzi, Giordano Diambrini (Univ., Genoa. Istituto Nazionale di Fisica Nucleare, Genoa). Rev. Mod. Phys., 40: 611-31(July 1968).

A survey of theoretical and experimental methods now available for calculating, producing, and measuring high-energy coherent bremsstrahlung (HEB) and electron pair production (EPP) is presented. After the historical development of the subject matter is sketched, a preliminary theoretical approach is outlined. A rough classical argument is shown, and a formal expression of the Laue–Bragg law suitable for the next calculation is deduced, together with some fundamental kinematics of the HEB and EPP processes. The structure factors for the cubic, face-centered cubic, and diamond lattice are deduced and some qualitative features of the interferential cross sections are shown. A complete calculation of the HEB and EPP cross sections is carried out. HEB polarized and unpolarized cross sections as functions of recoil momentum are obtained and then integrated over all the reciprocal lattice space. Corresponding results for EPP cross sections are expressed and numerical calculation results are shown. Experimental methods and techniques used in different laboratories in order to produce and measure high-energy coherent bremsstrahlung suitable for photoproduction experiments by polarized photons are discussed. Experimental apparatus and results are described in some detail. Finally, concluding remarks are made concerning the topics omitted. (auth)

44372 MOMENTS OF CASCADE CURVES IN IRON AND LEAD. Emel'yanov, Yu. A.; Lukin, Yu. T.; Amanov, K. A. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 7: 57-60(1967). (In Russian).

Calculations of the moments of cascade curves up to the fourth order inclusively were made with respect to the experimental cascade curves in iron and lead at primary particle energies of 100 GeV. The first and second moments, found experimentally, were compared with theoretical values. The dependence of the transition coefficients on the depth was calculated. (tr-auth)

44373 MOTION OF A CHARGED PARTICLE IN A UNIFORM MAGNETIC FIELD. Klein, J. J. (Univ. of Calgary, Alberta). Rev. Mod. Phys., 40: 523-30(July 1968).

The quantum mechanical study of the motion of a charged spin-$\frac{1}{2}$ particle in a uniform magnetic field has a number of features which are of interest to theorists. Not only can the Dirac equations be solved completely and analytical solutions be obtained, but unlike the Coulomb problem, the expressions for absorption and emission of radiation can be evaluated exactly with these exact Dirac wave functions without resorting to a multipole expansion of the usual sort that is made in the theory of the hydrogen atom. In the ultrarelativistic limit, reasonably simple, closed expressions can be obtained for synchrotron radiation, or photoproduction of electron–positron pairs in a magnetic field. The latter expression allows one to associate an absorption coefficient with the magnetic field in vacuo, and through the use of dispersion theory, to obtain the real (dispersive) part of the index of refraction. The use of exact wave functions, rather than plane waves, to describe the electron may simplify the anomalous-moment calculations and shed some light on the computation of the complete power series in α. (auth)

44374 MASS OF THE PHOTON. Kobzarev, I. Yu.; Okun, L. B. (Inst. for Experimental and Theoretical Physics, Moscow). Usp. Fiz. Nauk, 95: 131-7(May 1968). (In Russian).

The mass of photons represents an experimental, and not a theoretical problem. L. de Broglie was the first one to set an upper limit for this mass; later, Schrödinger improved the accuracy of the calculations used, and M. A. Ginzburg also examined the problem. The present state of the question is examined on the basis of the more recent experimental findings, showing how the mass of the photon would have affected its free motion in vacuum, and the interaction between charges and currents. The calculations indicated that the Compton wave length of the photon exceeds 30,000 km. The question arises whether the mass limit of the photon should not be set at a lower value, if the theory based on the zero mass becomes attractive. It was found that at present, none of the problems of the elementary particle theory would be simplified by assigning a mass to the photon. (TTT)

44375 ELECTRIC DIPOLE MOMENTS OF ELEMENTARY PARTICLES. Shapiro, F. L. (Joint Inst. for Nuclear Research, Dubna, USSR). Usp. Fiz. Nauk, 95: 145-58(May 1968). (In Russian).

The problem of the constancy of electric dipole moments of elementary particles became important in connection with the recently discovered nonconservation of the T-invariance in certain decay processes of neutral K mesons. Estimation of the electric dipole moments would be helpful for clarification of the problems involved in the nonconservation of the CP and T invariances. The experimental techniques are based on the shift of atomic levels, electromagnetic scattering reactions in the Coulomb field, and the precession of spin in an external electric field. The best estimates of the upper limit are $d_e < 3 \times 10^{-23}$ e.cm for the electron and $d_n < 3 \times 10^{-22}$ for the neutron. The strong nonconservation of the CP invariance in electromagnetic interactions leads to much higher estimated values for d_n. Experiments are in progress at Dubna on the enhancement of the electric dipole moment by atoms and ions. (TTT)

44376 ON THE ELECTROMAGNETIC INTERACTION OF INTERMEDIATE W BOSON. Belavin, A. A. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 7: 1267-71 (June 1968). (In Russian).

A general form of the electromagnetic vertex of W boson without C, P, and T invariance, is considered. A possible contribution of weak interactions to the electromagnetic structure of the W boson is discussed. Expressions for C-, P-, and T-odd correlations in the process $e^+ + e^- \rightarrow W^+ + W^-$ are found. (auth)

44377 GREEN'S FUNCTION OF A PARTICLE IN A UNIFORM EXTERNAL FIELD. Eftimiu, C.; Thompson, K. W. (Indiana Univ., Bloomington). J. Math. Phys. (N. Y.), 9: 586-7(Apr. 1968).

The exact propagator of a spinless charged particle in a uniform electromagnetic field with $|E| = |H|$ and $E \cdot H = 0$ is shown to lack the pole corresponding to the mass of the particle. (auth)

44378 ASYMPTOTIC GRAVITATIONAL FIELD OF THE ELECTRON. Martin, A. W.; Pritchett, P. L. (Stanford Univ., Calif.). J. Math. Phys. (N. Y.), 9: 593-7(Apr. 1968).

The Einstein–Maxwell equations appropriate to the exterior metric and fields of a source characterized by mass, electric charge, and magnetic dipole moment are formulated. Because of the presence of a nonvanishing Poynting vector, the metric tensor must include off-diagonal elements. A rigorous reduction of the metric tensor to three unknown functions is accomplished and the field equations are solved to second order in the gravitational constant. Using the parameters of the electron and proton, it is found that the magnetic dipole terms dominate the metric at small distances and that general relativistic effects become important at distances of the order of 10^{-22} cm. Possible applications of the asymptotic metric are discussed. (auth)

44379 ELECTRIC DIPOLE MOMENT OF A NUCLEON. Gourishankar, Radha (Univ. of Alberta, Edmonton). Can. J. Phys., 46: 1843-4(Aug. 15, 1968).

New upper limits for the electric dipole moment of a nucleon are obtained in a model proposed earlier, using the present experimental data on $K_2 \to 2\pi$ decays. (auth)

44380 CLASSICAL AND QUANTUM THEORIES OF SPINNING PARTICLES. Corben, H. C. San Francisco, Holden–Day, Inc., 1968. 293p. $8.75.

The basic unity of physics is stressed by means of the study of the equations governing the motion of a charged, spinning, magnetized point particle in an electromagnetic field. These equations are examined successively at the levels of nonrelativistic and relativistic classical mechanics, and nonrelativistic and relativistic quantum mechanics. Emphasis is placed on the correspondence between these various approximations. (J.F.P.)

44381 GENERALIZED DISPERSION SUM RULES AND THE A_2 TRAJECTORY IN PION PHOTOPRODUCTION. Vasavada, Kashyap V. (Univ. of Connecticut, Storrs); Raman, K. Phys. Rev. Lett., 21: 577-80(Aug. 19, 1968).

Generalized dispersion sum rules are used for determining the A_2 trajectory and residue function in pion photoproduction. The results favor the Gell–Mann mechanism of ghost elimination for the A_2 over the Chew and no-compensation mechanisms. (auth)

44382 SYSTEMATICS OF THE RELATIONS FOLLOWING FROM THE QUARK MODEL. IV. PHOTOPRODUCTION. Bialas, A. (Jagellonian Univ., Krakow. Inst. of Nuclear Physics, Krakow); Gula, A.; Muryn, B.; Zalewski, K. Nucl. Phys., B6: 483-6 (1968).

The quark model is applied to photoproduction processes. Relations for differential cross sections, relations for spin density matrices, and relations between strong and electromagnetic processes are derived and discussed. (auth)

44383 NEUTRON FORM FACTOR. Lo, S. Y. (Rutherford High Energy Lab., Chilton, Eng.). Phys. Lett., 27B: 308(Aug. 5, 1968).

From Chou-Yang's diffraction model it is found that the neutron form factor is proportional to proton form factor at all momentum transfer squared, in excellent agreement with experiment. (auth)

Weak

44384 (IFVE-STF-67-57-K) ON SEARCHES FOR HEAVY LEPTONS. Gershtein, S. S.; Folomeshkin, V. N. (Institut Fiziki Vysokikh Energii, Serpukhov (USSR)). 1967. 18p. (In Russian). Dep.

Various possibilities of heavy lepton production are discussed assuming that leptons participate in the electromagnetic and universal weak interactions only. It is noted that under these assumptions the negative results of the search for a heavy electron do not forbid a possible existence of a heavy electron with mass more than 500 MeV. An attempt is made to estimate the lower bound of the mass of the heavy muon (participating in the weak interaction with muonic neutrino or antineutrino) using the published results of the neutrino experiments in the CERN heavy liquid bubble chamber. (auth)

44385 (IFVE-STF-68-2-K) FROM WHAT EXPERIMENTAL DATA IS IT POSSIBLE TO DETERMINE THE DEGREE OF VIOLATION OF THE RULE $\Delta T = 1/2$ IN DECAY $K \to 3\pi$. Anisovich, V. V.; Dakhno, L. G.; Likhoded, A. K. (Institut Fiziki Vysokikh Energii, Serpukhov (USSR)). 1968. 14p. (In Russian). Dep.

The question is being studied how much the ħ- and K-mass differences affect the $\Delta T = 1/2$ violation. It is shown that the division of the total decay rates into their phase space, as is usually the case, does not exclude entirely the effect of mass differences on the total decay rates. Owing to the ħ- and K-mass differences in various decays the physical region is shifted as well as the middle point of the Dalitz plot. Since the matrix elements of the $K \to 3\hbar$ decay depend essentially on the pion energy, the appreciable corrections appear in the total decay rates (of the order 10%). As a result of claiming a 40% precision, the only relation exists in the case when the $T = 1/2$ rule is fulfilled, if the π-ħ-interaction at low energy is small. These relations are violated only by the transitions with $\Delta T = 5/2$ and $\Delta T = 7/2$. In conclusion other possibilities for determining the corrections to the $\Delta T = 1/2$ rule in $K \to 3\hbar$ decays are discussed. (auth)

44386 (ITEF–580) CONCERNING THE RENORMALIZABLE THEORY OF WEAK INTERACTIONS. Shabalin, E. P. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1967. 18p. (In Russian). Dep.

The Tanikawa-Watanabe model for renormalizable theory of the weak interaction is investigated in view of recent experimental data. The variant of the theory, as presented by Tanikawa and Watanabe, is shown to be in contradiction with the available data. A new variant is established that is in agreement with modern data. Corrections and correlations for the $e^{\pm}p$, $M^{\pm}p$ scatterings due to the weak interactions are substantial in the new variant of the theory, so the validity of the theory may be tested if the experimental precision be increased. (auth)

44387 SECOND-ORDER WEAK PROCESSES AND WEAK-INTERACTION CUTOFF. Mohapatra, R. N.; Rao, J. Subba; Marshak, R. E. (Univ. of Rochester, N. Y.). Contract AT(30-1)-875). Phys. Rev., 171: 1502-8(July 25, 1968). (UR–875-230).

The problem of the weak-interaction cutoff Λ was studied with the universal current–current theory (UFI) and the intermediate-vector-boson (IVB) model, using the Bjorken technique to treat the high-energy behavior and the "hard meson" technique of Weinberg and Schnitzer. With these methods, the most divergent contributions to the second-order weak decay $K_L^0 \to \mu\bar{\mu}$ and $K_L^0 - K_S^0$ mass difference Δm are essentially independent of strong interaction. From $K_L^0 \to \mu\bar{\mu}$ decay, $\Lambda \lesssim 35-100$ BeV, and from Δm, $\Lambda \simeq 3-4$ BeV. With this latter value of Λ, the predicted rate of $K_L^0 \to \mu\bar{\mu}$ is reduced to a value obtained by Bég treating this process as first-order in weak and second-order in electromagnetic interaction. The Bég calculation is redone with the algebra of currents, and the soft-kaon contribution to $K_L^0 \to \mu\bar{\mu}$ is calculated with both the UFI and IVB models. A possible origin of the low value of Λ deduced from Δm is discussed. (auth)

44388 MOUNTING EVIDENCE FOR THE EXISTENCE OF A NEUTRAL VECTOR BOSON. Neito, Michael Martin (State Univ. of New York, Stony Brook). Phys. Rev. Lett., 21: 488-90 (Aug. 12, 1968).

It is pointed out that the existence of a strangeness-zero, neutral, vector boson with mass O(30 GeV) and strong coupling to muons is consistent with the recent experimental results on the anomalous magnetic moment of the muon, the direct production of high-energy muons in cosmic rays, and the observations of multiple-core cosmic-ray events with high momentum transfers. A discussion is given in which two feasible experiments are mentioned that could test the model. (auth)

44389 VECTOR AND AXIAL-VECTOR MESON DOMINANCE IN THE $K_{3\pi}$ DECAYS. Graham, R. H.; Yun, S. K. (Syracuse Univ., N. Y.). Phys. Rev., 171: 1550-5(July 25, 1968).

A model for $K \to 3\pi$ decays is proposed in which the amplitudes are assumed to be dominated by vector and axial-vector meson poles. S-wave and P-wave amplitudes are treated on the same footing in this scheme. The strong-coupling constants appearing in the model can be determined from strong decays. The $K \to 3\pi$ slopes and average amplitude ratios are then determined in terms of one parameter characterizing the $\Delta I = 1/2$ part of the weak Hamiltonian. Estimates are made of the effects of a $\Delta I = 3/2$ contribution to the weak interaction. (auth)

44390 NONLEPTONIC DECAYS OF HYPERONS AND CURRENT ALGEBRA. Chan, Francis C. P. (Brandeis Univ., Waltham, Mass.). Phys. Rev., 171: 1543-9(July 25, 1968).

Nonleptonic decays of baryons are studied within the framework of current algebra, current-current interaction, and hard pions. A formalism which avoids the usual ambiguity of off-mass-shell extrapolation for the P-wave decays is developed, from which formulas for the decay amplitudes can be derived. Two models are discussed. The first model contains the equal-time commutator and the baryon pole terms, but allows for the SU(3) symmetry breaking through the presence of the parity-violating spurion matrix elements between baryons. The second model adds the $3/2+$ decuplet and $Y_0^*(1405)$ contributions to the first model, but the SU(3) symmetry-breaking matrix elements are not considered. Reasonable agreement with experiment is obtained in both models. (auth)

44391 RADIATIVE CORRECTIONS TO K^0_{e3} DECAYS AND THE $\Delta I = \frac{1}{2}$ RULE. Ginsberg, Edward S. (Univ. of Massachusetts, Boston). Phys. Rev., 171: 1675-80(July 25, 1968).

The radiative corrections to the Dalitz plot in K^0_{e3} decays are calculated assuming a phenomenological weak K-π vertex and using perturbation theory. The answer depends logarithmically on a cutoff, as is the case for nuclear β decay. An interesting feature of these decays is that they offer a means of measuring the q^2 dependence of the form factors $f_\pm(q^2)$. The radiative corrections contribute an additional energy dependence which cannot be separated experimentally. It is found that the radiative corrections are considerable, i.e., greater than 3% in absolute magnitude, over a large portion of the Dalitz plot, and are not particularly sensitive to a reasonable choice of cutoff. The corrections to the lepton and pion spectra, and the decay rate are also given. A comparison with previous results for K^0_{e3} reveals that the K^+_{e3} correction is of the same order of magnitude but everywhere more positive. In particular, the ratio of the decay rates $\Gamma(K^0_{e3})/\Gamma(K^+_{e3})$, which is equal to 2 according to the $\Delta I = \frac{1}{2}$ rule, must be modified by a factor $(1 + \delta)$ due to the radiative corrections. It is found that $\delta \simeq 1\frac{1}{4}\%$ and is independent of the cutoff. (auth)

44392 RENORMALIZATION OF WEAK FORM FACTORS, AND THE CABIBBO ANGLE. Quinn, H. R.; Bjorken, J. D. (Stanford Univ., Calif.). Phys. Rev., 171: 1660-1(July 25, 1968).

It is argued that renormalization corrections in K_{e3} decay reduce the magnitude of the decay amplitude $f_+(0)$ from that given by exact SU(3). (auth)

44393 LEWIS–OPPENHEIMER–WOUTHUYSEN MODEL APPLIED TO NEUTRINO REACTIONS. Sakitt, Barbara (Columbia Univ., N. Y.). Contract AT(30-1)-1932. Phys. Rev., 171: 1715-23(July 25, 1968). (NYO-1932(2)-134).

The cross sections for pion production by neutrinos and the charge-exchange scattering of neutrinos by nucleons are calculated. The weak-interaction Hamiltonian is taken as a product of nucleon and lepton currents. The Lewis–Oppenheimer–Wouthuysen model is used to compute the production matrix elements between nucleon-pion states given by the intermediate-coupling approximation. The results agree moderately well with the experiments using 2-BeV neutrinos. (auth)

44394 FORM FACTOR, SCHWINGER, AND QUASILOCAL TERMS IN THE AXIAL PART OF $\pi \to e\nu\gamma$ DECAY. Berezinskii, V. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 7: 1251-60(June 1968). (In Russian).

A relation between the form factors of the axial parts of the decays $\pi \to e\nu\gamma$, $\pi \to e\nu$ and the pion electromagnetic on-shell and off-shell form factor was found. The quasilocal term is calculated and the compensation of the Schwinger terms and divergence of quasilocal terms is shown that allows one to find the Schwinger terms which appeared to be an operator with $\Delta T = 1$. The dependence of the axial form factor on the momentum transfer squared is found assuming the octet dominance and the $\pi - A_1$ dominance (the pole dependence). The results are compared with the experimental data. (auth)

44395 RELATION BETWEEN CROSS SECTIONS FOR ELASTIC NEUTRINO AND ANTINEUTRINO SCATTERING BY NUCLEI FROM ALGEBRA OF CHARGES. Kim, C. W. (Johns Hopkins Univ., Baltimore); Ram, M. Phys. Lett., 27B: 306-7(Aug. 5, 1968).

An interesting relation between the cross sections for elastic neutrino and antineutrino scattering by nuclei is derived using the closure approximation and the charge commutation relations conjectured by Gell-Mann. (auth)

44396 $A_{1-\rho-\pi}$ SYSTEM AND $\pi \to l\nu\gamma$ DECAY. Riazuddin (Univ. of Islamabad, Rawalpindi, Pakistan); Fayyazuddin. Phys. Rev., 171: 1428-31(July 25, 1968).

It is pointed out that an accurate experimental determination of the ratio r of the structure-dependent axial-vector to the vector contribution in $\pi \to l\nu\gamma$ decay can settle the question of subtraction in the dispersion relation for the relevant amplitude which determines the axial-vector contribution in this decay, as well as in the electromagnetic form factor of the pion. Further, it is shown that the value of r is sensitive to the value of the parameter γ which enters into the $A_{1-\rho-\pi}$ system for theoretical determination of the $A_1 \to \rho\pi$ and $\rho \to 2\pi$ widths. (auth)

44397 NOTE ON THE GEOMETRIC THEORY OF NEUTRINOS. Collinson, C. D. (Univ. of Hull, Eng.). J. Math. Phys. (N. Y.), 9: 625-7(Apr. 1968).

The geometric theory of neutrinos proposed by Penney is investigated. It is shown, from the conditions imposed, that the space-time is conformally flat. All solutions of the field equations are found and attention is paid to the limiting process described by Penney. (auth)

44398 NEUTRINO PRODUCTION OF ALL BARYON STATES. II. Malamant, Alexandre; Kessler, Paul (College de France, Paris). Cah. Phys., No. 206, 389-406(Oct. 1967). (In French).

The method of Feynman diagram calculation is applied to third order processes of the type $\nu(\bar{\nu}) + N \to (1 + N^*) \to 1 + N + \pi$, where N^* is any resonance of given spin and parity. On the other hand, the particular process $\nu + N \to \mu + N^*_{33}$, for which numerical calculations were carried out, was considered using the CVC hypothesis for the vector part of the current, and two alternative models ("peripheral"and PCAC) for the axial part. The results are compared to the available experimental data and discussed. (auth)

44399 CURRENT ALGEBRA, SPECTRAL FUNCTION SUM RULES AND THE $f_-(0)/f_+(0)$ RATIO IN K_{l3} DECAY. Riazuddin (Univ. of Islamabad, Rawalpindi, Pakistan); Sarker, A. Q.; Fayyazuddin. Nucl. Phys., B6: 515-22(1968).

The ratio $\xi(0) = f_-(0)/f_+(0)$ in K_{l3} decay was calculated by using the algebra of currents and the spectral-function sum rules. A value consistent with its experimental value obtained from the $K_{\mu3}$ and K_{e3} branching ratio is found. (auth)

44400 THEORETICAL STUDY OF K_{l4} DECAY. Berends, F. A. (Univ. of Glasgow); Donnachie, A.; Oades, G. C. Phys. Rev., 171: 1457-65(July 25, 1968).

K_{l4} decay is formulated in a way which allows the extraction of form factors and $\pi - \pi$ phase-shift differences from data with limited statistics. The only assumptions required are T invariance and a restriction to S and P waves in the final state, no other dynamical assumptions being required. It is shown that the assumption of the $\Delta I = \frac{1}{2}$ rule is not necessary if all K_{l4} decays are taken into account. When the existing available data are analyzed in the simple extension of the Cabibbo-Maksymowicz approach in which all P-wave contributions are taken into account, there is a sign ambiguity in the S-wave $\pi - \pi$ phase shift. This ambiguity is fundamental to this approach and can be solved only by means of another angular distribution. Such a distribution could be obtained from the existing data. (auth)

Strong (General)

Refer also to abstracts 43724 and 44487.

44401 (KFKI-13/1968) LITTLE GROUPS, ANALYTICITY AND FAMILIES OF REGGE TRAJECTORIES. (AN ELEMENTARY APPROACH). Domokos, G. (Magyar Tudomanyos Akademia Atommag Kutato Intezete, Budapest). 1968. 22p. Dep.

A brief review of some ideas which have contributed to recent developments of Regge pole theory is given. These developments lead to an increased understanding of the properties of composite particles and also resolve some difficulties. After a brief review of some aspects of the representation theory of the Poincaré group the group properties of composite states are studied, and it is shown how the difficulties of Regge pole theory can be traced to certain properties of their spin algebra. This immediately gives the means of solving the difficulties and also leads to some physical consequences of which a few are briefly mentioned. The underlying physical ideas are emphasized at the expense of mathematical rigor. (J.F.P.)

44402 (SLAC-PUB-463) IS THE POMERANCHON AN ORDINARY REGGE TRAJECTORY. Harari, Haim (Stanford Linear Accelerator Center, Calif.). Aug. 1968. 29p. Dep. CFSTI.

The possible relation between Regge poles and cuts and various optical models for high-energy hadron collisions is discussed, and a specific model for the Pomeranchuk trajectory is considered. The point of view is presented that there are already a sufficiently large number of experimental facts which demand exotic Regge poles and possibly cuts, that it is probably possible to fit all existing data with such poles and cuts, in many cases the fits are insignificant because the assumed model has too much freedom, and there may exist some other physical picture of high-energy reactions which is outside the usual model of t-channel exchange of poles and cuts. Some general questions related to the possible peaceful coexistence of an optical picture and a Reggeistic description are discussed. The nature of the Pomeranchuk trajectory and its possible diffractive origin are analyzed, and a model which distinguishes between the Pomeranchon and the other ordinary trajectories is presented. (J.F.P.)

44403 (UCR-34-P-107-73) ANNUAL REPORT [ON HIGH ENERGY PHYSICS]. Kaus, P. E.; Desai, B. R. (California Univ., Riverside). June 1968. Contract AT(11-1)-34. 54p. Dep. CFSTI.

Theoretical research on Regge pole theory for hadron interactions and production, under AEC contract AT(11-1)34 P107A at the University of California, Riverside, is reviewed. (J.F.P.)

44404 NONLOCAL CURRENTS AS COORDINATES FOR PARTICLES. Soln, J. (Univ. of Wisconsin, Milwaukee). Phys. Rev., 171: 1773-81(July 25, 1968).

The possibility of formulating the dynamic theories in terms of nonlocal "currents" is investigated. As an example, the nonrelativistic system of n identical particles (with and without spin) is formulated. From these models it is learned that the extension to relativistic systems is possible. This is illustrated by treating the Thirring model in terms of nonlocal currents. (auth)

44405 ASYMPTOTIC VERTEX FUNCTION IN A CROSSING-SYMMETRIC BOOTSTRAP MODEL OF THE HADRONS. Harte, John (Univ. of California, Berkeley). Phys. Rev., 171: 1825-31 (July 25, 1968). (UCRL-18122).

An asymptotic solution to an off-shell, nonlinear, crossing-symmetric bootstrap equation for the vertex function is found, thus determining the explicit dependence of the asymptotic vertex function on all three variables. The equation bootstraps the entire vertex function rather than just the coupling constant, and describes the constituents of a composite particle as composite particles. The asymptotic solution is characterized by a constant which is shown to be universal, i.e., independent of the types of particles coupling to a given vertex. This allows the relative rates of decrease of all hadronic form factors to be predicted. The predicted behavior for the $NN\gamma$ and the $N^*N\gamma$ form factors is in good agreement with experiment. Several extensions and further tests of the theory are proposed and will be discussed in future papers. (auth)

44406 CONSPIRACY RELATIONS FOR UNEQUAL-MASS PROCESSES. Stack, John D. (Univ. of Illinois, Urbana). Phys. Rev., 171: 1666-7(July 25, 1968).

A new technique of derivation is utilized to write down and classify all the $t = 0$ conspiracy relations for the reactions $1 + N \rightarrow 2 + N$. (auth)

44407 POSSIBLE MECHANISM FOR STRUCTURE IN AN INELASTIC RESONANCE. Coulter, Philip W.; Shaw, Gordon L. (Univ. of California, Irvine). Phys. Rev. Lett., 21: 634-6 (Aug. 26, 1968).

A situation in which one might observe a two-peak structure which is in fact a single, broad, inelastic resonance is suggested. Starting with an inelastic factor η which has a single smooth dip, but differs somewhat from a Breit–Wigner form, it is found that the Ball–Frazer mechanism generates a two-peak resonance. (auth)

44408 RELATIVISTIC WAVE EQUATION FOR SPIN-½ PARTICLE. Ionescu-Pallas, N. J. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 13: 461-9(1968).

Besides the well-known splitting formalism due to Dirac, an alternative way for reaching the relativistic wave equation of ½ spin particle is the factorization in the framework of Pauli algebra. All the three kinds of relativistic wave equation—Gell-Mann and Feynman, Weyl, Dirac—are obtained simply by resorting exclusively to Pauli 2×2 matrices. This time, Gell-Mann and Feynman equation plays an essential role, for the other equations are derived out of it by operations involving space reflection. The insertion of a scalar interaction requires, in this formalism, the concept of conformal space. Thus, two equivalent variants of Gell-Mann and Feynman equation are established for the case when a scalar interaction is present. One of these equations contains by no means the reflected spinor. Finally, the problems of invariance under space-time reflection as well as under chirality transformation are discussed. (auth)

44409 SYSTEMATICS OF THE RELATIONS FOLLOWING FROM THE QUARK MODEL. I. RELATIONS BETWEEN DIFFERENTIAL CROSS SECTIONS. Bialas, A. (Jagellonian Univ., Krakow. Inst. of Nuclear Physics, Krakow); Zalewski, K. Nucl. Phys., B6: 449-64(1968).

The examination of the assumptions necessary for the derivation of the relations between the cross sections for charge- and/or strangeness-exchange two-body processes following from the quark model suggests a natural division of these relations into five groups. The physical significance of the proposed division is supported by the existing experimental data which show a different degree of agreement for different groups of relations. (auth)

44410 THEORY OF MULTIPLE PRODUCTION AT HIGH ENERGIES. Kancheli, O. V.; Matinyan, S. G. Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 357-8(Mar. 1968). (In Russian).

Particle collisions with multiple production at high energies are investigated. The isobar and fireball mechanisms are discussed. A dynamic hypothesis is presented and the results following from this hypothesis are enumerated and analyzed. (R.V.J.)

Strong (Baryon No. = 0)

Refer also to abstracts 43766, 44396, 44441, and 44513.

44411 (ITEF-557) INVESTIGATION OF THE SPIN AND PARITY OF THE A_2 MESON. Vladimirskii, V. V.; Vasil'eva, O. N.; Lomkatsi, G. S.; Tikhomirov, G. D. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1967. 15p. (In Russian). Dep.

The new method of determination of the spin–parity of resonances decaying into 3π-mesons is described. This method was used to determine spin–parity of A_2-meson produced in reaction $\pi - p \rightarrow p\pi\rho$ at momenta of 3.25 GeV/c. (auth)

44412 GENERATION OF PARALLEL DAUGHTERS FROM SUPERCONVERGENCE. Rubinstein, H. R.; Schwimmer, A.; Veneziano, G.; Virasoro, M. A. (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Rev. Lett., 21: 491-5(Aug. 12, 1968).

A dynamical model based on superconvergence equations and Regge asymptotics generates parallel daughter trajectories for positive and negative t. The results are found by studying different reactions both by means of sum rules and the partial-wave analysis of Regge terms proposed by Schmid. (auth)

44413 NEW CLASS OF DISPERSION SUM RULES FOR FORWARD SCATTERING. George, David J.; Tubis, Arnold (Purdue Univ., Lafayette, Ind.). Phys. Rev. Lett., 21: 495-8 (Aug. 12, 1968).

New dispersion sum rules for cross sections, coupling constants, and low-energy scattering data are derived by considering modified forward-scattering amplitudes. A set of these sum rules, which involve highly convergent integrals, may be useful for testing low-energy phase-shift analyses of $\pi\pi$ and KN scattering. (auth)

44414 CURRENT ALGEBRA, WARD IDENTITIES, AND SPACE-SPACE EQUAL-TIME CURRENT COMMUTATORS. Schnitzer, Howard J.; Wise, Michael L. (Brandeis Univ., Waltham, Mass.). Phys. Rev. Lett., 21: 475-8(Aug. 12, 1968).

The technique of Bjorken is combined with the Ward identities for the time-ordered products of currents to obtain a correlation between space–space equal-time commutators and the high-energy behavior of the hadron proper functions. The method is illustrated for the three-point function of conserved isovector currents. (auth)

44415 INTERFERENCE OF KAON RESONANCES. Kane, G. L.; Mani, H. S. (Univ. of Michigan, Ann Arbor). Phys. Rev., 171: 1533-9(July 25, 1968).

Goldhaber has recently suggested that the $K\pi\pi$ system with an effective mass around 1300 MeV may contain two resonances of the same spin and parity, but belonging to SU(3) octets whose neutral, non-strange members have opposite eigenvalues under charge conjugation. The situations in which these mesons could, through their common $K\pi\pi$ decay mode, interfere in the $K\pi\pi$ effective-mass distribution are analyzed. In the SU(3) limit, for example, the two mesons can interfere in the $K^+\pi^+\pi^-$ mass if only events in the $K^{*0}\pi^+$ region of the Dalitz plot are analyzed, but they cannot interfere if both $K^{*0}\pi^+$ and ρ^0K^+ events are included. Effects of SU(3) breaking are also included both by putting in physical masses wherever possible, and by considering particle mixing, which vanishes in the SU(3) limit. (auth)

44416 SUM RULES FROM CHARGE–CHARGE-DENSITY AND CHARGE–CHARGE COMMUTATORS. Matsuda, S.; Oneda, S. (Univ. of Maryland, College Park). Phys. Rev., 171: 1743-9 (July 25, 1968).

The spectral-function approach to the broken-SU(3)-symmetry sum rules has two difficulties. One is the ambiguity with respect to the Schwinger terms, and the other is the derivation of the so-called second sum rules, which are not acceptable. By using commutators involving a charge operator, the approach is free of the first difficulty. In computation, the following approximation is made for the operator V_K [which is an SU(3) raising or lowering operator in the symmetry limit]: In the broken symmetry the operator V_K still acts as a generator, to a good approximation, in an appropriately chosen infinite-momenta limit. For the vector meson → l + l couplings, sum rules are derived which are essentially equivalent to the first spectral-function sum rules but not to the second ones. Instead, other sum rules are obtained which allow the first-order ω-ϕ mixing angle to be determined from the rates of V → l + l decays. A sum rule for the $\omega \rightarrow 3\pi$, $\phi \rightarrow 3\pi$, and $K^* \rightarrow K\pi\pi$ couplings is also obtained. The Gell-Mann–Zachariasen relation and its K* analog are also derived which favors the existence of the κ meson. (auth)

44417 INDUCTION OF SYMMETRIES FOR A SET OF MESONS OF BOTH PARITIES. Capps, Richard H. (Purdue Univ., Lafayette, Ind.). Contract AT-(11-1)-1428). Phys. Rev., 171: 1591-6(July 25, 1968). (COO-1428-41).

A bootstrap model for hypothetical sets of odd-parity mesons (M) and even-parity mesons (M′), developed recently by the author, is extended. Nontrivial solutions to the model must involve mesons of both parities. New consistency conditions are obtained by considering two-particle scattering amplitudes for which the product of the intrinsic parities of the four external particles is odd. It is shown that the symmetric (MMM′ and M′M′M′) interactions, as well as the antisymmetric interactions, must transform as simple representations of a Lie group. Many Lie groups do not lead to solutions. A solution based on SU(n) does exist; a crucial property of these groups (for n > 2) that is necessary for the solution is the existence of a symmetric interaction involving the regular representation states only. The consistency conditions are all expressible in terms of cummutator conditions similar to those applied to total charges in current algebra. (auth)

44418 SUM RULE BASED ON UNITARITY. Arbab, Farzam (Univ. of California, Berkeley); Slansky, Richard C. Phys. Rev., 171: 1785-91(July 25, 1968). (UCRL-18057).

Unitarity, analyticity, Regge asymptotic behavior, and a resonance approximation are combined to derive a new sum rule. The sum rule is very convergent; the contribution of high-mass resonances is suppressed by a decreasing weight function. The spin-flip and non-spin-flip residues of the ρ meson in the $\pi\pi \rightarrow N\bar{N}$ amplitude are evaluated at the mass of the ρ, and in conjunction with the first-moment finite-energy sum rule, a calculation of the ρ-meson mass is performed. The results are in good agreement with experiment. A calculation of the ρ and f_0 resonance parameters in the $\pi\pi \rightarrow \pi\pi$ amplitude is also discussed. (auth)

44419 AMPLITUDE PARITY AND X^0-MESON. Kundu, S. K. (Regional Coll. of Education, Orissa, India). Indian J. Phys., 41: 882-5(Dec. 1967).

The A-invariance of Bronzan and Low is discussed and its relevance to X^0-decay processes is examined for the spin parity alternatives $J^P = 0^-$ or 1^+. It is shown that A = 1 favors the present experimental observations. (auth)

44420 LOCAL FIELD THEORY AND ISOSPIN INVARIANCE. I. FREE-FIELD THEORY OF SPINLESS BOSONS. Carruthers, Peter (Cornell Univ., Ithaca, N. Y.). J. Math. Phys. (N.Y.), 9: 928-45(June 1968).

The properties of free-field theories of spinless bosons are investigated. The self-conjugate boson field theories of isospin $\frac{1}{2}$, $\frac{3}{2}$, $\frac{5}{2}$, . . . are shown to be nonlocal: the energy, isospin, and number densities fail to commute for spacelike separations. The difficulty is traced to the necessary occurrence of nonindependent field variables. For the anomalous case the dependent variables are nonlocally related to the independent ones; elimination of the former makes superficially local quantities depend nonlocally on the independent fields. The connection with canonical field theory is investigated. The p and q coordinates have anomalous commutation relations in the nonlocal case. Although the Hamiltonian appears normal in every case, the anomalous theories are characterized by zero (integrated) Lagrangian. Antiparticle conjugation is investigated in detail with attention to phase questions. For anomalous theories two types of conjugation are found, one of which nonlocally relates the field to a superposition of its adjoint. A unitary transformation is constructed which converts one type to the other. Finally, CPT transformation properties of normal and abnormal theories are derived and compared. (auth)

44421 $K_A \rightarrow K^*\pi$ AND $K^* \rightarrow K\pi$ DECAYS. Srivastava, Prem P. (CERN, Geneva). Notas Fis., Cent. Brasil, Pesqui. Fis., 13: No. 10, 219-27(1968).

Strong decays $K_A \rightarrow K^*\pi$ and $K^* \rightarrow K\pi$ are studied using current algebra, partial conservation of axial current, dispersion relations and Weinberg sum rules. The pions are treated as "soft" in the sense $k^2 \rightarrow 0$ instead of $k \rightarrow 0$. (auth)

44422 NOTE ON THE DYNAMICAL APPROACH OF SU$_3$ SYMMETRY. Rittenberg, V.; Marinescu, N.; Banyai, L. (Inst. of Physics, Bucharest). Rev. Roum. Phys., 13: 479-83(1968).

Assuming that pseudoscalar meson octet—pseudoscalar meson octet in the equal mass case, is described by the amplitudes of Cini-Fubini type with factorized spectral densities, it is proved that the unitarity conditions are compatible only with SU$_3$ symmetry and that selfbreaking does not occur. (auth)

44423 SIMPLE CONDITION FOR THE π-π SCATTERING LENGTHS USING CURRENT ALGEBRA. Ghika, Gr.; Visinescu, M. (Inst. for Atomic Physics, Bucharest). Rev. Roum. Phys., 13: 451-60(1968).

An attempt is made to calculate the scattering lengths T = 0 and T = 2 for the π-π scattering. For the scattering amplitude a forward dispersion relation is used and the value of the amplitude in the subtraction point is taken from current algebra. (auth)

44424 TOTAL CROSS SECTIONS AND THE REGGE POLE MODEL. Hara, Y. (Tokyo Univ.). Nucl. Phys., B6: 510-14 (1968).

Non-strange mesons are classified into four classes: (i) P $(-1)^J$, $G = (-1)^{I+J}$ (ii) $P = (-1)^J$; $G = -(-1)^{I+J}$, (iii) $P = -(-1)^J$, $G = (-1)^{I+J}$ and (iv) $P = -(-1)^J$, $G = -(-1)^{I+J}$. Contributions from these four types of mesons and their Regge trajectories to unpolarized and polarized total cross sections are studied. (auth)

44425 PHENOMENOLOGICAL BOUNDS ON $\pi\pi$ SCATTERING LENGTHS. Goebel, C. J.; Shaw, G. (Rutherford High Energy Lab., Chilton, Eng.). Phys. Lett., 27B: 291-5(Aug. 5, 1968).

Analyticity of a forward scattering amplitude, plus knowledge over any finite energy range of the ratio of total cross section to forward elastic differential cross section, puts a (negative) lower bound on the scattering length a. Such bounds are shown to be violated by all published $\pi\pi$ scattering solutions which have a large negative value of $a_{I=0}$ ($\lesssim -0.5\ \mu^{-1}$). (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 44411, 44555, 44602, and 44780.

44426 $K_2^0 + p \rightarrow K_1^0 + p$ AND THE REGGE TRAJECTORY OF THE ω MESON. Gilman, Frederick J. (Stanford Univ., Calif.). Contract AT(04-3)-515. Phys. Rev., 171: 1453-7(July 25, 1968). (SLAC-PUB-401).

The behavior of the process $K_2^0 + p \rightarrow K_1^0 + p$ at high energy is shown to be dominated near the forward direction by Reggeized ω exchange with an intercept $\alpha_\omega(0) \simeq 0.5$. It is shown how a study of the energy dependence and angular distribution in this process will determine the important characteristics of the ω Regge trajectory and residue functions. (auth)

44427 THRESHOLD AND PSEUDOTHRESHOLD RELATIONS FOR MESON–BARYON SCATTERING. Henyey, Frank S. (Univ. of Michigan, Ann Arbor). Phys. Rev., 171: 1509-11(July 25, 1968).

Jackson and Hite have recently studied the problem of removing kinematic singularities from scattering amplitudes by using essentially nonrelativistic angular momentum arguments. For the case of meson-baryon scattering, their results depend on the sign of the mass difference between the meson and baryon. This dependence indicates the presence of remaining kinematic singularities in these amplitudes. For some purposes one wishes to complete the program of Jackson and Hite, and remove these singularities. By considering the amplitudes as functions of the energy W, rather than its square s, these additional singularities are removed. The amplitudes found have only dynamic singularities as a function of s and t. There are, however, conditions between these amplitudes at thresholds and pseudothresholds. These conditions are adequately treated by Jackson and Hite. (auth)

44428 SOLUTION OF BETHE–SALPETER EQUATION WITH PADE APPROXIMANTS. Nieland, H. M. (Univ. of Nijmegen, Netherlands); Tjon, J. A. Phys. Lett., 27B: 309-11(Aug. 5, 1968).

The Bethe-Salpeter equation for the πN system in the ladder approximation with N exchange is solved in the elastic region using Padé approximants. It is shown that the lowest order diagonal approximant [1,1] is a bad approximation for this case. (auth)

44429 PREDICTION OF THE MEAN BACKWARD $\pi^- p \rightarrow \pi^0 n$ DIFFERENTIAL CROSS SECTION DOWN TO 2.0 GeV/c. Barger, V.; Cline, D. (Univ. of Wisconsin, Madison). Phys. Lett., 27B: 312-16(Aug. 5, 1968).

The $(N_\alpha, \Delta_\delta)$ Reggeized baryon exchange model which satisfactorily explains recent high energy backward $\pi^\pm p$ scattering data is shown to extrapolate through the mean $\pi^\pm p$ cross sections in the 2–5 GeV/c range. From this empirical observation it is suggested that intermediate energy measurements of $\pi^- p \rightarrow \pi^0 n$ backward scattering will allow a resolution of the relative sign ambiguity between the Δ_δ and N_α residues and serve as a further test of the Reggeized baryon exchange mechanism. (auth)

44430 ARGAND DIAGRAMS, BOOTSTRAP THEORIES, AND REGGE POLES. Alessandrini, V. A.; Squires, E. J. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Lett., 27B: 300-1(Aug. 5, 1968).

It is discussed whether all resonances should be expected to occur in the partial-wave projection of the cross-channel Regge pole formula. (auth)

44431 PROCESS $\pi^-p \to \pi^+\pi^-n$ NEAR THRESHOLD. Humble, S.; Spearman, T. D. (Trinity Coll., Dublin). Phys. Rev., 171: 1724-30(July 25, 1968).

A phenomenological analysis was made of the process $\pi^-p \to \pi^+\pi^-n$ near the pion-production threshold. The basis for this analysis consisted of treating formally the two-pion system in the final state as though it were a single system $\tilde{\sigma}$ with T = J = 0 but with a continuous mass spectrum. A partial-wave decomposition was made of the $\pi N \to \tilde{\sigma}N$ pseudo-two-to-two-particle scattering amplitude, and all partial-wave amplitudes except that for which the σ n state is in the s wave were given the values obtained from the single-pion-exchange graph. The remaining amplitude with an s-wave $\tilde{\sigma}$ n final state was calculated separately. By assuming that of the three final-state particles only the two pions provided an important interaction, a phenomenological form for this partial wave was derived in terms of the D function arising in an N/D solution for the T = J = 0 pion-pion amplitude. All the partial waves were then combined to calculate the low-energy differential cross sections, and the values of the various parameters were adjusted to give an optimum fit to the experimental data. The most satisfactory fit to the data was obtained with a T = J = 0 phase shift whose scattering length was negative but soon turned over and became positive. (auth)

44432 TWO-BODY K^-d REACTIONS AS A TEST OF ONE-MESON EXCHANGE. Schillaci, M. E.; Silbar, R. R. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 171: 1764-7 (July 25, 1968). (LA-DC-9482).

Cross sections for the reaction $K^-d \to YN$ are estimated using the one-meson-exchange triangle diagram mechanism, apparently successful for prediction of forward $pp \to d\pi^+$. The rates for $K^-d \to \Lambda n$ are particularly large around 1-GeV/c incident kaon momentum: ≈300 μb for forward Λ's (one-pion exchange), and ≈150 μb for backward Λ's (one-kaon exchange). The rates for $K^-d \to \Sigma N$ are much smaller and strongly peaked forward. (auth)

44433 SUPERCONVERGENCE AND REGGE POLES. I. ODD-SIGNATURE EXCHANGES. Olsson, M. G. (Univ. of Wisconsin, Madison). Contract AT(11-1)-881. Phys. Rev., 171: 1681-9 (July 25, 1968). (COO-881-160).

A method is used in which the usual analytic properties of the πN scattering amplitude are exploited in a more complete way to obtain information about ρ-type Regge poles. It is found that the low-energy data determine the forward Reggeized ρ-meson-exchange parameters quite accurately. These are found to be in complete agreement with high-energy analyses. It is also seen that in the forward direction, only ρ-meson exchange is allowed to a very good approximation. The evaluation of low-energy parameters and the prediction of forward pion charge-exchange scattering are also discussed. A criterion is given relating the validity of the ''interference'' model to the behavior of the general sum rule. (auth)

44434 PION-NUCLEON SCATTERING AND SO(4) SYMMETRY. Macfadyen, N. W. (Univ. of Cambridge, Eng.). Phys. Rev., 171: 1691-8(July 25, 1968).

The pseudoscalar-meson-baryon scattering amplitude at vanishing momentum transfer is investigated using the well-known O(4) symmetry. Many of the features of spinless particle scattering are reproduced, but the different representation functions lead to some special features, and parity-doubling of the Regge trajectories is found. First-order correction formulas for expansions near the symmetry point are derived, and some possible applications to the baryon resonances are investigated phenomenologically. (auth)

44435 PION-NUCLEON SPIN-FLIP CURRENT-ALGEBRA SUM RULE. Radescu, Eugen E. (Inst. of Atomic Physics, Bucharest, Rumania). Phys. Rev., 171: 1655-9(July 25, 1968).

Current algebra, unsubtracted dispersion relations, and the hypothesis of partially conserved axial-vector current imply a model-dependent sum rule (derived by Gerstein) for the spin-flip pion-nucleon scattering amplitude, analogous to the one obtained by Weisberger and Adler for the non-slip-flip amplitude. The Gerstein sum rule requires information about the weak amplitude for axial-vector-nucleon scattering; an attempt is made to evaluate its contribution on the basis of two different models. The first model consists in saturating the weak amplitude with the $N^*(\frac{3}{2},\frac{3}{2})$ (1238 MeV) and $N^{**}(\frac{1}{2},\frac{3}{2})$ (1518 MeV) resonances, using a number of existing theoretical determinations of the N^* and N^{**} axial coupling constants. The second evaluation is done with a very simple assumption of additivity in the quark model, and leads to a poor, but not discouraging, verification of the Gerstein sum rule. (auth)

44436 PION PRODUCTION, CURRENT ALGEBRA, AND COUPLING-CONSTANT RELATIONS. Mitra, A. N.; Nath, R. (Univ. of Delhi). Phys. Rev., 171: 1798-1804(July 25, 1968).

The techniques of current algebra are applied to the process $\pi N \to \pi\pi N$, with a view of obtaining certain coupling-constant sum rules. The emphasis is on the evaluation of the limit when all three pions become soft. While the matrix elements for such a process all vanish in this limit, it is possible to use a suitable limiting procedure to obtain nontrivial relations involving various strong coupling constants and certain low-energy π-π parameters. The entire formalism is based on using an extensive pole model for the evaluation of the $\pi N \to \pi\pi N$ matrix elements. The problem of ambiguous terms which have a more complicated structure in such processes is treated in some detail. One of the interesting results is an independent determination of the pion scattering lengths (in terms of the known coupling constants of hadrons), in almost exact agreement with Weinberg's original result. (auth)

44437 POSSIBILITY OF A BRANCHING EFFECT IN p AND p′ POLES IN πN SCATTERING. Levintov, I. I. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 7: 934-6(Apr. 1968). (In Russian).

Following up theoretical considerations that Regge poles cannot exist in an isolated manner but are always accompanied by a series of branching points, the question arose how to observe such branching phenomena in the scattering of high-energy particles. V. N. Gribov derived a relation involving the potential observation of branching effects in πN scattering. If his formula does not apply, it may be assumed that branching does occur. Breakdown of the validity of the equation was demonstrated on the basis of amplitude relations of $\pi^\pm p$ scattering and in charge exchange, involving summing of poles. On this basis, it may be stated that the inapplicability of the formula could be considered an experimental proof of branching phenomena involving p and p′ poles. (TTT)

44438 CENTRIFUGAL-BARRIER EFFECTS IN N/D CALCULATIONS. Childers, R. W. (Univ. of Tennessee, Knoxville). Phys. Rev., 171: 1540-3(July 25, 1968).

It is shown in a simple, zero-parameter model that inclusion of the background forces representing the effects of the centrifugal barrier substantially modifies the results of partial-wave calculations. (auth)

44439 APPROXIMATE BOUNDS ON COUPLING CONSTANTS FROM ANALYTICITY, CROSSING, AND UNITARITY. Atkinson, D.; Calogero, F. (Univ., Rome. Istituto Nazionale di Fisica Nucleare, Rome). Phys. Rev., 171: 1767-72(July 25, 1968).

If the exchange forces in a unitary scattering amplitude are too large, there is a breakdown of analyticity due to the appearance of ghosts. As an illustration of this, the condition that the singlet amplitudes of nucleon-nucleon scattering have no ghosts is formulated as a simple eigenvalue problem for the bound on the pion-nucleon coupling constant, in the approximation of neglecting all but one-pion-exchange terms. It is found that the pion-nucleon coupling constant g could not be more than $2\frac{1}{2}$ times its actual value without producing a ghost. It is suggested that the most stringent bounds should come from a consideration of the Pomeranchuk pole. It is further speculated that the electromagnetic and weak interactions may eventually be bounded in a similar way. (auth)

44440 POSSIBLE DECUPLET OF $\frac{5}{2}^+$ BARYON RESONANCES. Gueret, Philippe; Jenkovszky, L. (Univ., Paris. Joint Inst. for Nuclear Research, Dubna, USSR). Compt. Rend., Ser. A and B, 266: 1549-50(June 24, 1968). (In French).

The possible existence of a decuplet of $\frac{5}{2}^+$ baryon resonances is considered from the calculation of the relations of decay probabilities of the type $\frac{5}{2}^+ \to \frac{1}{2}^+ + 0^-$, and their comparison with experimental results. (tr-auth)

44441 CURRENT COMMUTATORS AND MASS EXTRAPOLATIONS, THEORY, AND APPLICATIONS. Balachandran, A. P. (Inst. for Advanced Study, Princeton, N. J. Syracuse Univ., N. Y.); Gundzik, M. G.; Nicodemi, F. Nucl. Phys., B6: 557-84(1968).

The equal-time commutation relations of axial vector currents and an off-mass-shell extrapolation are used to compute the S- and

P-wave scattering lengths and S-wave effective ranges of some of the meson-baryon and meson-meson elastic scattering amplitudes. The results are in reasonably good agreement with experimental data wherever the latter are available. The technique for obtaining these numbers is developed and analyzed in some detail. The analyticity and unitarity properties of off-mass-shell partial-wave amplitudes are investigated and some results which may be generally useful in off-mass-shell calculations are presented. (auth)

44442 APPROXIMATIONS IN THE CALCULATION OF CAPTURE RATES IN K^- MESIC ATOMS. Rook, J. R. (Nuclear Physics Lab., Oxford. Univ. of California, Berkeley). Nucl. Phys., B6: 543-53(1968).

Nuclear capture rates were previously calculated from K^- mesic atoms using formulas obtained by semi-classical arguments. It is shown that the use of these formulas as opposed to the more complete quantal ones leads to errors of less than 30%. (auth)

44443 REGGE-POLE MODEL WITH ABSORPTIVE CORRECTIONS FOR THE REACTIONS $\pi^- + p \rightarrow \pi^0 + n$ AND $\pi^+ + p \rightarrow \pi^0 + \Delta^{++}(1238)$. Schrempp, F. (Institut fuer Experimentalphysik, Hamburg). Nucl. Phys., B6: 487-509(1968).

A Regge-pole model with absorptive corrections is presented for quasi-two-body reactions. It turns out that these corrections correspond to a Regge-cut contribution, with its branch point equal to the one resulting from two-Regge-pole exchange. In the case of πN charge exchange, the s and t dependences of the recoil-neutron polarization are predicted in a satisfactory manner, especially if one uses a complex absorption factor resulting from a three-Regge-pole fit to the elastic πN scattering data. The kinematical t singularities and t zeros of the helicity amplitudes are not determined by the commonly used method, i.e., by the aid of the crossing relation, but rather by comparing the ρ Regge-pole amplitudes with the corresponding ρ meson-pole graph at $t \approx m_\rho^2$. In the case of the reaction $\pi^+ p \rightarrow \pi^0 \Delta^{++}$ it is thus possible to isolate additional kinematical zeros at $t = 0$ and $t = (m_\Delta - m_N)^2$. Taking these zeros into account leads to rather weakly varying residues between $t = 0$ and $t = m_\rho^2$. The values of the residues determined at $t = 0$ from a fit to the data favor the assumption of a dominating M1 transition at the $N\rho\Delta$ vertex. Accordingly, the $\Delta(1238)$ density-matrix elements exhibit only a weak t dependence in the pure Regge-pole model. However, the absorptive corrections make the density-matrix elements substantially more t-dependent in good agreement with the data. (auth)

44444 SYSTEMATICS OF THE RELATIONS FOLLOWING FROM THE QUARK MODEL. II. CONSTRAINTS ON DECAY DISTRIBUTIONS OF RESONANCES. Bialas, A. (Jagellonian Univ., Krakow. Inst. of Nuclear Physics, Krakow); Zalewski, K. Nucl. Phys., B6: 465-77(1968).

Decay distributions of the resonances produced in quasi-two-body processes are discussed in the framework of the generalized quark model. Only results which can be obtained without comparing different reactions are considered. The quark model relations among density matrix elements are divided into three groups differing in their behavior under changes of the spin reference frames. The relations contained in the first two groups are found to be consistent with the experimental data. The relations from the third group seem in disagreement with the data. A tentative interpretation of these results is given. (auth)

44445 SYSTEMATICS OF THE RELATIONS FOLLOWING FROM THE QUARK MODEL. III. COMPARISON OF DECAY DISTRIBUTIONS OF RESONANCES PRODUCED IN DIFFERENT REACTIONS. Bialas, A. (Jagellonian Univ., Krakow. Inst. of Nuclear Physics, Krakow); Zalewski, K. Nucl. Phys., B6: 478-82(1968).

The relations between the decay distributions of resonances produced in quasi-two-body reactions are discussed in the framework of the quark model. (auth)

44446 MODEL OF s- AND p-WAVE πN SCATTERING. Serebryakov, V. V.; Shirkov, D. V. (Inst. for Mathematics, Novosibirsk, USSR). Nucl. Phys., B6: 607-16(1968).

A generalization of the CGLN equations for the s and p partial waves of low-energy pion-nucleon scattering is constructed which explicitly takes into account the contributions from the $\pi\pi \rightarrow NN$ annihilation channel with the aid of an effective Lagrangian. It is shown that these equations describing only the long-range effects can not give a simultaneous quantitative description of s and p waves; and the 33-dominant solution leads to a contradiction with the universality of the vector interaction in the effective Lagrangian. A simple way of accounting the short-range effects with the aid of phenomenological repulsion potentials is suggested. In the static limit a solvable system of equations for the s- and p-waves is obtained. Its 33-resonance solution leads to a reasonable agreement between the experimental values of all scattering lengths, the 33-resonance parameters and the constants of the effective Lagrangian, satisfying the Sakurai condition of universality. (auth)

44447 POSSIBLE ZERO AT A WRONG-SIGNATURE SENSE POINT IN BACKWARD $\pi^- p$ ELASTIC SCATTERING. Igi, Keiji (Argonne National Lab., Ill.); Matsuda, Satoshi; Oyanagi, Yoshio; Sato, Hikaru. Phys. Rev. Lett., 21: 580-2(Aug. 19, 1968).

A possible zero at the wrong-signature sense point $\alpha_\Delta = \frac{1}{2}$ on the exchanged Δ_δ trajectory is suggested in connection with the new Cornell–Brookhaven National Laboratory experiments on the $\pi^- p$ backward peaks. (auth)

44448 BACKWARD ($\theta = 180°$) πN DISPERSION RELATIONS: APPLICATIONS TO THE INTERFERENCE MODEL P AND P′ TRAJECTORIES, AND TO THE MECHANICAL FORM FACTORS OF THE NUCLEON. Goldberg, Hyman (Northeastern Univ., Boston). Phys. Rev., 171: 1485-94(July 25, 1968).

On the basis of Mandelstam analyticity, crossing, and the observed drop of the backward (180°) $\pi^\pm p$ differential cross sections with energy, a set of unsubtracted dispersion relations is written for the πN amplitudes $A^\pm$, $B^\pm$ at fixed $\theta = \pi$. A further application of crossing allows the derivation of separate sum rules on A^- and B^+, which are not of the superconvergent variety, and which provide us with information about $\overline{N}N \rightarrow \pi\pi$ scattering. In particular, a value of the spin-flip $f^0(1250)$-N-N coupling constant is deduced, which is shown to permit the following observations: (1) the residue function of the P (or P′) trajectory in πN scattering changes sign between $t = 0$ and $t = m_f^2 = 1.56$ GeV^2, and (2) universal coupling of the $f^0(1250)$ meson to the gravitational stress-energy density and the knowledge of the aforementioned coupling constant fixes the zero-momentum-transfer values of two of the three mechanical form factors. The values are given in the text. Lastly, an extended discussion is presented of the Barger–Cline model within the context of backward dispersion relations. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 44370, 44439, and 44516.

44449 VELOCITY-DEPENDENT POTENTIAL PARAMETRIZATION FOR $^1S_0$ ELASTIC PROTON–PROTON SCATTERING. Brolley, John E. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. Phys. Rev., 171: 1439-41(July 25, 1968). (LA-DC-9042).

A four-parameter velocity-dependent potential utilizing Gaussian functions and the one-pion-exchange potential has been fitted to the most recent proton–proton elastic scattering phases. Phases generated by the present solution essentially reside within the corridor of error. (auth)

44450 STATISTICAL THEORY AND PARTICLE SCATTERING AT LARGE ANGLES. Sisakyan, I. N.; Chernavskii, D. S. Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 346-9(Mar. 1968). (In Russian).

Published precision data obtained on elastic proton scattering at large angles ($\theta \sim 90°$, where θ is an angle in the cms system) at energies from 5 to 20 GeV were analyzed. (R.V.J.)

44451 NUCLEON–NUCLEON POTENTIAL CONSISTENT WITH EXPERIMENT AND THE BOSON EXCHANGE THEORY OF NUCLEAR FORCES. Lomon, Earle L.; Feshbach, Herman (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Ann. Phys. (N.Y.), 48: 94-172(June 1, 1968). (MIT-2098-368).

The nucleon–nucleon data are fitted by a boundary condition and model interaction determined largely by field-theoretic forms. One and two pions, ρ, ω, and η meson exchange adiabatic local potentials determine the interaction for $r \geq \frac{1}{2}\mu$ where $(1/\mu)$ is the pion Compton wavelength. The two-pion-exchange contribution contains a degree of ambiguity measured by the parameters ξ and λ for the pion-ladder and nucleon-pair diagrams, respectively. The interaction at r_0 is given by an energy-independent boundary condition for each partial wave sensitive to the short-range interaction. A very good fit to the pp data and a good fit to the np data below 350-MeV-nucleon laboratory energy comparable to the better phenomenological fits are obtained. The optimum or fixed value of exchange-particle masses and coupling constants correspond to their available measured values, and the λ and ξ parameters optimize in their theoretical range. The value obtained for r_0 corresponds to that predicted by the theory of the boundary-condition model. There remain 19 boundary-condition parameters freely fitted to which the data is sensitive. Rescattering and long-range recoil corrections remain to be investigated, as does the effect of coupling to inelastic channels. (auth)

44452 HIGH-ENERGY HADRON–NUCLEUS COLLISIONS. I. PROTONS. Goldhaber, Alfred S.; Joachain, Charles J. (Univ. of California, Berkeley). Contract W-7405-Eng-48. Phys. Rev., 171: 1566-80(July 25, 1968). (UCRL–17985).

A semiclassical theory is developed to describe high-energy ($\gtrsim$10 BeV) reactions of hadrons with large nuclei. Coulomb phase effects are important, and they are accurately included in the formulas obtained. The theory is applied to data of Bellettini et al. at CERN for scattering of 19.3-BeV/c protons on large nuclei. Semiquantitative agreement of theory and experiment is obtained. However, for the case of a lead target, variation of the parameters in the theory did not produce a theoretical curve which agreed with the experimental p-Pb differential cross section over the entire range of angles measured. To obtain agreement at the smallest angles (before the first diffraction dip), it seems necessary to assume a much more diffuse nuclear surface than is indicated by electron scattering data. This is the regime in which the theory should be most reliable. To reproduce the oscillations in the data at larger angles, one seems forced to assume a fairly sharply defined surface, only slightly more diffuse than electron scattering suggests. Reasons are given why the effective nucleon density may be more diffuse for proton scattering than for electron scattering. Further experiments are suggested. (auth)

44453 MODIFIED BORN APPROXIMATION AND ELASTIC SCATTERING BY WEAK CENTRAL POTENTIALS. Dutta, S. K.; Wilson, W. A.; Green, A. E. S. (Univ. of Florida, Gainesville). J. Math. Phys. (N. Y.), 9: 578-85(Apr. 1968).

When only a few partial waves are substantially phase shifted and yet many partial waves are slightly phase shifted, it is possible to use the direct Born approximation, provided that one projects out the inaccurate lower partial waves and replaces them by accurate theoretical or phenomenological phase shifts. This technique is tested for central potentials with two different well strengths, i.e., one which will fail to bind the 1S wave, and one which can bind the 1S state. Numerically generated angular distributions and total cross sections are compared with those obtained from a modified form of the direct Born approximation. The technique would be useful for weak forces, e.g., the nucleon–nucleon and electron–atom interactions, but inapplicable for strong forces, e.g., atom–atom interaction. (auth)

44454 COMPARISON OF HIGH-ENERGY NEUTRON–PROTON AND PROTON–PROTON ELASTIC SCATTERING. Cox, J. (Stanford Linear Accelerator Center, Calif.); Perl, M. L.; Kreisler, Michael N.; Longo, Michael J. Phys. Rev. Lett., 21: 645-7 (Aug. 26, 1968).

Neutron-proton and proton-proton elastic scattering are compared in the momentum range from 3 to 7 GeV/c. At the same incident momenta the np and pp diffraction peaks have similar slopes, and both peaks shrink with increasing momentum. Over this momentum range the 90° np cross section is 1.1 ± 0.1 times the 90° pp cross section. Differential cross sections for nucleon-nucleon scattering with isospin 0 are compared with those for isospin 1. (auth)

44455 ABSORPTION OF POSITIVE PIONS AT LOW ENERGY BY THE DEUTERON. Cheon, Il-tong (Kyoto Univ. Kobe-Gakuin Coll., Japan); Tohsaki, Akihiro. Nucl. Phys., B6: 585-95(1968).

A πNN interaction including the rescattering effects is derived on the basis of Miyazawas theory to investigate the pion absorption by light nuclei. The reaction $\pi^+ + d \rightarrow p + p$ at low energies is analyzed with this interaction. (auth)

44456 SPIN EFFECTS IN THE SCATTERING OF PROTONS FROM LIGHT NUCLEI AND A POSSIBLE TEST FOR THE EXISTENCE OF REGGE CUTS. Kujawski, E.; Sachs, David; Trefil, J. S. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Lett., 21: 583-5(Aug. 19, 1968).

An analysis is made of the effects of spin dependence in proton-deuteron and proton-helium scattering. Using spin-dependent amplitudes consistent with experiments both p-α and p-D scattering are fitted simultaneously. The above result may constitute a test for Regge cuts in the N-N scattering amplitude. (auth)

44457 MEASUREMENTS OF C_{NN} IN PROTON–PROTON SCATTERING FROM 305 TO 415 MeV. Beretvas, A. (Univ. of Chicago). Phys. Rev., 171: 1392-8(July 25, 1968).

The spin–spin correlation parameter C_{NN} for p–p scattering was measured at four energies between 305 and 415 MeV. Measurements were made over the angular range of 50° to 90° in the c.m. system. A polarized beam, produced by scattering of the internal proton beam of the Chicago cyclotron, and the Argonne polarized proton target were used for the experiment. Results for C_{NN} (90°) are compared with other experiments. The total set of experimental data indicates a strong energy dependence for C_{NN} (90°) with a minimum at approximately 500 MeV. A brief qualitative discussion of the behavior of C_{NN} (90°) is given. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 44289, 44470, and 44490.

44458 WAVE EQUATIONS WITH BROKEN U(3,1) SYMMETRY. Shin, Ernest E. H. (Univ. of Miami, Coral Gables, Fla.). Phys. Rev., 171: 1652-4(July 25, 1968).

"Quadratic" and "linear" wave equations of Nambu and Kursunoğlu type, respectively, with broken U(3,1) symmetry, are investigated in the (3 + 1)-dimensional oscillator model. It is shown that there exists a complete set of nontrivial solutions satisfying both equations simultaneously. An alternative scheme which avoids the usual complications of an oscillator with noncompact unitary symmetry is proposed. (auth)

44459 EMBEDDING OF SU(3) IN SU(8). Carlstone, D. S. (Purdue Univ., Lafayette, Ind.). Phys. Rev., 171: 1527-32 (July 25, 1968).

The fact that SU(8) symmetry has recently been applied to the nonleptonic decays of baryons, both in a pole model and in a current-algebra model, suggests a closer look at this symmetry. The SU(8) algebra is constructed so that the SU(8) structure is preserved. The possible application of other physical processes is then considered. It is shown that with certain restrictive assumptions, approximate octet dominance follows from a current-current interaction. (auth)

44460 SECOND-QUANTIZATION PROCESS FOR PARTICLES WITH ANY SPIN AND WITH INTERNAL SYMMETRY. Nelson, T. J.; Good, R. H. Jr. (Iowa State Univ., Ames). Rev. Mod. Phys., 40: 508-22(July 1968). (IS–1705).

The second-quantized theory of free particles and antiparticles, with any spin and with internal SU(2) or SU(3) symmetry, is developed. All spins and both statistics are treated in a uniform way in terms of well-defined complete sets of functions that are orthonormal with respect to a Lorentz-invariant positive-definite inner product. Explicit formulas for field operators of energy, momentum, etc., are given, including three-vector, four-vector, and tensor operators for polarization. It is shown that causal space densities of physical quantities exist when the correct spin-statistics connection is used. The field operators for systems self-conjugate under C, G, and GP are treated and self-conjugate multiplets of SU(3) are set up. (auth)

44461 INHOMOGENIZATIONS AND COMPLEX REPRESENTATIONS. Berzi, Vittorio (Univ., Milan. Istituto Nazionale di Fisica Nucleare, Milan); Gorini, Vittorio. J. Math. Phys. (N.Y.), 9: 829-36(June 1968).

Real Lie-algebra inhomogenizations are considered for complex defining representations and some emphasis is devoted to the case when the defining representation is irreducible. A theorem is given concerning the conditions under which nonequivalent complex representations give rise to isomorphic inhomogenizations and a classification is made of the complex inhomogenizations of semisimple Lie algebras. (auth)

44462 LIE-GROUP AND LIE-ALGEBRA INHOMOGENIZATIONS. Berzi, Vittorio (Univ., Milan. Istituto Nazionale di Fisica Nucleare, Milan); Gorini, Vittorio. J. Math. Phys. (N.Y.), 9: 816-28(June 1968).

A systematic formulation of the concept of inhomogenization is given both for Lie groups and for Lie algebras, and the connection between the two structures is clarified in terms of the notion of semidirect product. Special emphasis is devoted to the classification of the inhomogenizations of semisimple Lie algebras. As an application, a lemma due to O'Raifeartaigh is generalized to a wide class of inhomogeneous structures. (auth)

44463 ZERO-MASS REPRESENTATIONS OF THE POINCARE GROUP IN AN 0(3,1) BASIS. Mukunda, N. (Syracuse Univ., N. Y.). J. Math. Phys. (N. Y.), 9: 532-6(Apr. 1968).

Unitary irreducible representations of the Poincaré group, corresponding to zero mass and finite helicity, are reduced with respect to the subgroup of homogeneous Lorentz transformations. The action of the energy–momentum operators in the basis suited to this reduction is examined. (auth)

44464 ENHANCEMENT OF SU(3) BREAKINGS AND REGGE TRAJECTORIES. Suzuki, Mahiko (Inst. for Advanced Study, Princeton, N. Y.). Phys. Rev., 171: 1791-8(July 25, 1968).

The enhancement theory of symmetry breaking is formulated from a field-theoretical viewpoint so as to enable us to compare the enhancement condition with the existence of scalar mesons. By incorporating knowledge of Regge theory, it is concluded, in part, (i) that, to the lowest order of medium-strong SU(3)-breaking interactions, the F/D ratio of octet enhancement in the octet baryons is equal to that of the 2^+-meson Regge-trajectory coupling with the baryons, and (ii) that octet enhancement is appreciably larger in the weak and medium-strong SU(3) breakings than in the electromagnetic SU(3) breaking, if one takes account of all orders of medium-strong SU(3) breaking. Both predictions are in good agreement with experiment. All predictions from tadpole or Reggeized-tadpole models also follow. They are derived in an approximation corresponding to the two-body multichannel approach to the bound-state problem. A prescription is given to generalize them to more general cases. Our discussion prefers a certain class of ghost-killing mechanisms in Regge theory. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 44375, 44376, and 44486.

44465 (ITEF-560) CONCERNING $\Xi \rightarrow \Lambda\pi\gamma$ DECAYS. Zakharov, V. I. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1967. 18p. (In Russian). Dep.

It is shown that amplitudes of $\Xi \rightarrow \Sigma\pi$ transitions may be determined through measurement of the probability of hard photon emission and the magnitude of correlation between hyperon polarization and photon momentum in decays $\Xi \rightarrow \Lambda\pi\gamma$. Determination of these amplitudes is of interest from the point of view of checking SU(3) symmetry which allows one to express matrix elements of these transitions in terms of observable nonleptonic decay amplitudes. Partial widths which are to be measured are of order 10^{-3}–10^{-6} of the full width of Ξ hyperon. (auth)

44466 (UCSB-34-P-135-6) COMPARISON OF π^+ AND π^- LIFETIMES TO CHECK CPT INVARIANCE. Caldwell, David O.; Elings, Virgil B.; Hesse, William P.; Morrison, Rollin J. (California Univ., Santa Barbara. Dept. of Physics); Ayres, David S.; Cormack, Allan M.; Greenberg, Arthur J.; Kenney, Robert W. (California Univ., Berkeley. Lawrence Radiation Lab.). July 1968. Contract AT(11-1)-34. 13p. Dep. CFSTI.

A precise experiment was performed to look for any difference between the total lifetimes of the π^+ and its anti-particle, the π^-. Observation of such a difference would be direct evidence for a violation of CPT invariance in the weak decay of the charged pion. This is the second π^+/π^- lifetime ratio experiment at the 184-inch cyclotron and again involves counting the number of surviving pions as a function of distance, using a liquid hydrogen (or deuterium) Cherenkov counter. However, the beam flux was increased two orders of magnitude and the apparatus was entirely rebuilt so as to reduce considerably systematic errors. It is now found that $\tau_+/\tau_- = 1.00064 \pm 0.00069$, and thus (to a much better precision than has heretofore been available) no evidence for CPT violation in this decay. Also an improved value for the π^- lifetime was obtained, and although this analysis is not completed, a preliminary value is $\tau_- = 25.97 \pm 0.04$ nsec. (auth)

44467 ELECTROMAGNETIC T-ODD CORRELATIONS IN THE DECAY $\Xi^- \rightarrow \Sigma^0 e\bar{\nu}$ AND RADIATIVE β DECAY OF BARYONS. Khriplovich, I. B. (Inst. of Nuclear Physics, Novosibirsk, USSR). Yadern. Fiz., 7: 1261-6(June 1968). (In Russian).

Electromagnetic T-odd correlations in the decay $\Xi^- \rightarrow \Sigma^0 e\bar{\nu}$ are calculated. These correlations are due to the nonvanishing imaginary part from the graphs, one corresponding to the decay $\Xi^- \rightarrow \Lambda e\bar{\nu}\gamma$ with the subsequent transition $\Lambda\gamma \rightarrow \Sigma^0$. With these correlations measured one can determine the $\Sigma^0\Lambda$-transition magnetic moment and the magnetic moment of Σ^0 hyperon. However, for this purpose, one needs to observe about 10^9 events of the $\Xi^- \rightarrow \Sigma^0 e\bar{\nu}$ decay. The probability of the radiative baryon β decay, like $\Xi^- \rightarrow \Lambda e\bar{\nu}\gamma$, is also calculated. (auth)

44468 $\Delta I = \frac{1}{2}$ RULE IN CURRENT–CURRENT MODELS OF CP VIOLATION. Holstein, Barry R. (Carnegie-Mellon Univ., Pittsburgh). Phys. Rev., 171: 1668-75(July 25, 1968).

Current–current models of CP violation of the types discussed by Glashow and Alles are applied to the decay $K \rightarrow 2\pi$, using current algebra and partially conserved axial-vector current. It is found that the CP-violating amplitude may violate the $\Delta I = \frac{1}{2}$ rule even though the CP-conserving amplitude does not. It is not, however, possible to predict the ratio $K_L \rightarrow \pi^0\pi^0$ to $K_L \rightarrow \pi^+\pi^-$ in a model of this type. (auth)

44469 ON A POSSIBLE TEST OF CPT INVARIANCE. Lapidus, L. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 7: 1290-4(June 1968). (In Russian).

Discussion is given of a possible test of the CPT invariance in the weak interactions measuring a certain phase. Relations generalizing the Wolfenstein relation are obtained. These relations show the sensitivity of the considered test to possible deviations from the Wolfenstein relation. (auth)

44470 MATRIX ELEMENTS OF OPERATORS OF CLASS I REPRESENTATIONS OF SL(n, C). Fronsdal, C.; Harun-Ar-Rashid, [A. M.] (International Centre for Theoretical Physics, Trieste, Italy). J. Math. Phys. (N.Y.), 9: 959-64(June 1968).

Let D be an irreducible representation of the group SL(n,C) by operators T_g in a Hilbert space H. A canonical basis of vectors $h \in H$ is introduced. It is shown how to evaluate the "D-functions" $(h_1,T_g h_2)$. It was suggested that one such function has the physical interpretation of the electric-charge form factor of the pion. This function is evaluated in detail. (auth)

44471 DYNAMIC SYMMETRY OF THE RELATIVISTIC SYMMETRIC COULOMB PROBLEM IN THE CASE OF A CONTINUOUS SPECTRUM. Malkin, I. A.; Man'ko, V. I. (Moscow Physical-Technical Inst.). Zh. Eksp. Teor. Fiz., 55: 287-96 (July 1968). (In Russian).

It is shown that in the relativistic symmetric Coulomb model the states of a continuous spectrum with a fixed energy $E > m$ yield a single infinite dimensional irreducible representation of the dynamic group $SL(2,c) \otimes SU_2$. Relative to its important subgroup $SL_j(2,C)$ this representation can be decomposed into two irreducible ones with $m = -1$, $\rho = -i + 2\alpha ZE\,(E^2 - m^2)^{-1/2}$ and $m = 1$, $\rho = +i + 2\alpha ZE\,(E^2 - m^2)^{-1/2}$. However when $E = m$ the $SL_j(2,C)$ representation is not fully reducible. Similar results were obtained for a Pauli electron in a Coulomb field. It is also demonstrated that $SL(2,C) \otimes SU(2,2)$ is a dynamic group related to the model of the relativistic quadratic equation. The solutions of the continuous spectrum relative to the subgroup $SL_j + (2,C)$ are classified. (auth)

44472 REFLECTIONS IN SPACE, TIME, AND MATTER. Weigold, Erich. Res. Rev. (Office Aerosp. Res.), 7: No. 3, 3-4(Mar. 1968).

Charge conjugation, parity and CP violations and the CPT theorem are reviewed. There is no direct observation of a violation of time reversal invariance, but it is noted that if T conservation is found valid in K_2^0 decay, the CPT theorem would be disproved. (J.F.P.)

44473 PARITY-CONSERVING HYPERON NONLEPTONIC DECAYS IN SU(3). Taha, M. O. (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., 171: 1481-5(July 25, 1968).

General restrictions on the SU(3) invariants are found such that an experimentally satisfactory one-parameter solution of the parity-conserving nonleptonic hyperon decays is obtained under octet dominance and CP invariance. Both normal and abnormal charge conjugation are considered. The pole model is discussed as an example. In this model the restrictions determine the $B\bar{B}M$ and spurion F/D ratios, for which reasonable values are obtained. (auth)

Applications (Strong)

Refer also to abstract 44401.

44474 NOTE ON THE CHIRAL-DYNAMIC-LAGRANGIAN CALCULATION OF THE X^0 DECAY. Majumdar, D. P. (State Univ. of New York, Stony Brook). Phys. Rev. Lett., 21: 502-5 (Aug. 12, 1968).

The decay rate and the energy asymmetry of the η particle observed in the strong decay $\chi \rightarrow \eta + 2\pi$ are discussed in the context of $SU(3) \otimes SU(3)$ chiral dynamic Lagrangian. (auth)

44475 ON GETTING $U_3 \times U_3$ MESON–BARYON CROSS-SECTION RELATIONS FROM SU(3). Sarker, A. Q. (Univ. of Islamabad, Rawalpindi, Pakistan). J. Natur. Sci. Math., 7: 117-19(Oct. 1967).

It is pointed out that all the relations between meson–baryon scattering cross sections, which were obtained by Ruegg and Volkov assuming $U(3) \times U(3)$ symmetry for collinear processes follow also from SU(3) symmetry assuming that the contributions from [10] and [10*] representations in the scattering amplitudes vanish. For the meson–baryon scattering process $M + B \rightarrow M' + B'$ the notation (MB) is introduced for the elastic scattering amplitude, and the notation $\langle M'B'|MB\rangle$ for the production amplitude. It is well-known that there are eight independent parameters in the meson–baryon scattering processes coming from the reduction $8 \times 8 = 1 + 8_1 + 8_2 + 10 + 10^* + 27$. The amplitude in the t-channel is diagonalized. After the standard reductions and the evaluation of the Clebsch–Gordan coefficients, the contributions from the eight independent amplitudes to the various scattering processes are shown. (J.F.P.)

44476 EXTENSION THEOREM AND REPRESENTATIONS. Sankaranarayanan, A. (Iowa State Univ., Ames). J. Math. Phys. (N. Y.), 9: 611-20(Apr. 1968).

An extension theorem prescribing a method for constructing the (n + 1)-dimensional Lorentz group O(n,1) from the n-dimensional inhomogeneous rotation group, proved earlier, is recapitulated, and some comments on the theorem are made. The prescription is used to construct the unitary irreducible representations of the Lorentz groups O(2,1), O(3,1), and O(4,1), and it is found that only a limited number of representations are allowed. (auth)

44477 POINCARE AND LORENTZ INVARIANT EXPANSIONS OF RELATIVISTIC AMPLITUDES. Vinternitz, P.; Smorodinskii, Ya. A.; Sheftel, M. B. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 7: 1325-38(June 1968). (In Russian).

Discussion is presented of the double expansions of relativistic amplitudes in terms of the irreducible representations of the homogeneous Lorentz group, suggested recently for arbitrary values of the kinematical variables s and t. The relation of these expansions to the relativistic phase shift analysis in terms of representations of various little groups of the Poincaré group, is studied. (auth)

Field Theories

General

Refer also to abstract 44497.

Quantum Field Theory

Refer also to abstracts 43763 and 44299.

44478 CONSTRUCTION OF LOCAL QUANTUM FIELDS DESCRIBING MANY MASSES AND SPINS. Abarbanel, Henry D. I.; Frishman, Y. (Stanford Univ., Calif.). Phys. Rev., 171: 1442-52(July 25, 1968). (SLAC-PUB-390).

The possibility of constructing, out of particle creation and destruction operators, local quantum fields that transform as representations of the homogeneous Lorentz group is discussed. The immediate goal is to write down a consistent local quantum field theory which can simultaneously describe many particles with different masses and spins. In the case that the field is a finite-dimensional irreducible Lorentz tensor, the program is carried out with no restrictions on the masses considered as functions of the spin, provided the usual connection between spin and statistics is satisfied. However, when the field transforms as a unitary irreducible representation of the homogeneous Lorentz group (an infinite-dimensional representation), the requirement of locality, along with the physical assumption that the masses are bounded below, $m(j) \geq m_0 > 0$, leads to the restriction that the masses are independent of the spin. This property is shown to hold when the transformation law of the field is taken to be an irreducible finite-dimensional representation $\otimes$ a unitary irreducible representation. The physical consequences of this result and possible methods for evading it are discussed. Finally, an Appendix is included, where the related problem of orthogonality properties of timelike solutions to infinite-component wave equations is examined. In particular, it is shown that when the solutions of such wave equations transform as unitary irreducible representations of the homogeneous Lorentz group, only the Majorana representations support a scalar product, which is orthogonal for different spins. (auth)

44479 FORMAL BREAKDOWN OF LORENTZ INVARIANCE IN TWO-DIMENSIONAL FIELD THEORIES. Guralnik, G. S. (Brown Univ., Providence); Hagen, C. R. Phys. Rev., 171: 1431-8(July 25, 1968). (NYO-2262TA-171).

Since the field theory which describes the interaction of a massless fermion with a vector meson of bare mass μ_0 in one spatial dimension is known to contain massless boson excitations, there is considerable interest associated with the question of whether these particles can be identified as the Goldstone bosons generated by the breaking of an appropriate symmetry operation of the theory. It is shown that such an interpretation is indeed consistent, independent of the strength of the coupling, provided that one takes Lorentz invariance to be the broken symmetry of the model. Particular attention is given to the limits $\mu_0 \rightarrow \infty$ (Thirring model) and $\mu_0 \rightarrow 0$ (Schwinger model). It is found in all cases that despite the apparent breaking of Lorentz invariance, the excitation spectrum has a normal form, and the symmetry breakdown remains entirely unobservable. (auth)

44480 WAVE EQUATIONS ON A HYPERPLANE. Hammer, C. L.; McDonald, S. C.; Pursey, D. L. (Iowa State Univ., Ames). Phys. Rev., 171: 1349-57(July 25, 1968). (IS-1747).

The Dirac equation, the Weaver-Hammer-Good wave equations, and the Weinberg wave equations are written in a manifestly covariant form in terms of hyperplane parameters according to Fleming's hyperplane formalism. A Foldy-Wouthuysen-type wave equation is developed for the Weinberg theory and it, along with the usual Foldy-Wouthuysen wave equation and transformation, is also written in a manifestly covariant form for all spin. Fleming's formalism is extended to include the case where the hyperplane parameters are operators as well as c numbers. As a consequence, a hyperplane observer which corresponds to the particle rest frame is considered, with the result that wave equations are obtained in the usual manifestly covariant form for all spin with no auxiliary conditions or unphysical solutions. (auth)

44481 QUANTIZED GAUGE FIELD THEORY OF CHIRAL SYMMETRY. Yao, York-peng (Univ. of Michigan, Ann Arbor). Phys. Rev., 171: 1702-7(July 25, 1968).

It will be shown that a consistent quantized gauge field theory of chiral symmetry can be formulated within the framework of the Gürsey models. The freedom of unitary transformations is emphasized, especially with respect to the problem of the decoupling of the A_1-meson field from the pion field. In the lowest order, the theory reproduces the same results as those calculated from other approaches. However, the higher-order terms are different. (auth)

44482 SUBSIDIARY CONDITION IN QUANTUM ELECTRODYNAMICS. Haller, Kurt (Univ. of Connecticut, Storrs); Landovitz, Leon F. Phys. Rev., 171: 1749-61(July 25, 1968).

The subsidiary condition $\partial A_\mu^{(+)}/\partial x_\mu|n\rangle = 0$, usually known as the "Gupta–Bleuler" condition, is shown to be inadequate as a criterion for defining physical states in quantum electrodynamics in the Lorentz gauge. The condition is shown not be be covariant and to fail to define state vectors that remain in the physical subspace. An alternative subsidiary condition, which is satisfactory, is discussed and is shown to require an extensively different formulation of the collision problem in quantum electrodynamics. Some possible physical consequences of the inadequacy of $\partial A_\mu^{(+)}/\partial x_\mu|n\rangle = 0$ are proposed; these include effects in the decays of short-lived particles, and the fact that in some types of strong interactions, acting simultaneously with electromagnetic ones, S-matrix elements may occur which predict transitions from the physical space into the part of space in which the subsidiary condition is violated. The solution to the collision problem for stable charged particles that have only electromagnetic interactions is shown to be identical to that obtainable from the present theory. (auth)

44483 RELATIVISTIC LAGRANGIAN FIELD THEORY FOR COMPOSITE SYSTEMS. Fronsdal, Christian (Univ. of California, Los Angeles). Phys. Rev., 171: 1811-24(July 25, 1968).

It is shown that infinite-component field theories provide a useful alternative to the Bethe–Salpeter equation as a fully relativistic treatment of composite systems. Scattering amplitudes obtained by models of this type satisfy both Mandelstam analyticity and conspiracy requirements. Current algebras are saturated with a combination of discrete and continuous spectra. Most of the paper is devoted to a special example, for which it is found that the mass spectrum has a discrete part (bound states) and a continuous part (scattering states); that the metric in physical Hilbert space is positive definite; and that vertex functions and scattering amplitudes are analytic functions of s and t, with singularities at the same locations as in local field theory. The role of "spacelike solutions" is studied in detail, with some surprising results. (auth)

44484 DYNAMICAL APPARATUS OF THE DISPERSION APPROACH FOR QUANTUM ELECTRODYNAMICS. Pavlov, V. P.; Sukhanov, A. D. (Mathematics Inst., Moscow). Yadern. Fiz., 7: 1295-1305(June 1968). (In Russian).

An improved version of the Lagrangian formalism for quantum electrodynamics is presented. The theory is defined by the given type of currents in terms of the Heisenberg fields. Effects of the operator renormalization of the wave functions are taken into account exactly. The highest currentlike operators are found which help to obtain the equal-time commutator algebra of fields and currents. The commutator of electromagnetic currents is trivial. The commutator of electromagnetic and spinor currents contains a gauge term disappearing at $Z_3 = 1$. (auth)

44485 PROBLEM OF THE DYNAMIC APPARATUS OF QUANTUM FIELD THEORY IN THE AXIOMATIC METHOD. Medvedev, B. V.; Polivanov, M. K.; Sukhanov, A. D. (Mathematics Inst., Moscow). Zh. Eksp. Teor. Fiz., 55: 179-92(July 1968). (In Russian).

A number of problems of the dynamic apparatus of quantum field theory in the axiomatic method are considered. The Wick theorem relating the quasi-normal and ordinary degrees of the Heisenberg fields is established. The concept of a generalized variation derivative is introduced which in renormalized theories permits one to linearize the equations proposed by Medvedev for current-like operators Λ_v. A number of theorems concerning the properties of the operators are proved. An example of a theory with a finite number of untrivial operators Λ_v is presented and explicit expressions for the operators are obtained. (auth)

44486 INTERMEDIATE BOSONS AND THE ELECTROMAGNETIC FIELD. Lee, T. D. (Columbia Univ., New York). Contract AT(30-1)-1932. Phys. Rev., 171: 1731-42(July 25, 1968). (NYO-1932(2)-136).

Possible symmetries between the (hypothetical) charged intermediate-boson field $W_\nu^\pm$ and the derivative of the electromagnetic field $\partial F_{\mu\nu}/\partial x_\nu$ are investigated. It is assumed that (a) the total electromagnetic current operator $I_\nu\gamma = e_0^{-1}(\partial F_{\mu\nu}/\partial x_\nu)$ is proportional to a neutral member W_ν^0 of the intermediate-boson fields, (b) all hadron mass differences between different members of the same isospin multiplet consist of finite $O(e^2)$ terms but no $O(f^2)$ terms, and (c) all known leptonic, semileptonic, and $\Delta S \neq 0$ nonleptonic weak processes are transmitted by a single $W_\nu^\pm$ field, where f, e, and e_0 are, respectively, the semiweak coupling constant, the renormalized charge, and the unrenormalized charge. The simplest model compatible with (a), (b), and (c) is found to be one consisting of six intermediate bosons, which may be regarded as forming an SU_3 triplet and its Hermitian conjugate. Assumption (a) also implies finite radiative corrections for other processes such as weak decays, charge renormalization, etc. The unrenormalized charge e_0 is shown to be finite, bounded by the inequality $1 \leqq (e_0/e) \leqq \sqrt{2}$. A lower limit of f^2 is established. Neglecting higher-order corrections, this lower limit of f^2 is found to be $\frac{4}{3}e^2\sec^2\theta$ and, in this limit, $e_0 = \sqrt{2}e$ and $m_W/m_N \cong \alpha^{-1}$, where α is the fine structure constant, m_W and m_N are, respectively, the $W^\pm$ mass and the nucleon mass, and θ is the Cabibbo angle. The same model can also lead, in a reasonably natural way, to CP nonconservation. (auth)

44487 FIELD-THEORETIC FORMULATION OF THE BOOTSTRAP HYPOTHESIS. Kaus, P. (Univ. of California, Riverside); Zachariasen, F. Contracts AT(11-1)-68; AT(11-1)-34. Phys. Rev., 171: 1597-1613(July 25, 1968). (CALT-68-149; UCR-34P107-59).

A precise statement of the bootstrap theory in the language of conventional Lagrangian field theory is given. Under no further assumptions than the Mandelstam representation, it is shown that this closed-form theory is equivalent to the more usual S-matrix formulation in terms of Regge trajectories. The assumptions of the bootstrap theory are stated in terms of the vanishing of well-defined renormalization constants Z. All standard results and approximation methods in the bootstrap theory are shown to follow directly from the Z = 0 conditions. (auth)

44488 FIVE DIMENSIONAL FIELD THEORY. Oliveira, Colber G. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Cent. Brasil. Pesqui. Fis., 13: No. 9, 195-215(1967).

A unitary field theory is constructed in a Riemannian space R_5 which has cylindrical symmetry with respect to a unit vector field. The field is described by fifteen potentials which satisfy in the absence of external sources the five-dimensional Einstein equations $G_{\mu\nu} = 0$. It is shown that a four-dimensional analysis of this theory includes three types of force fields, the electromagnetic field, the gravitational field as described by general relativity, and a relativistic scalar field. (J.F.P.)

44489 CURRENT FORMALISM. I. ORDERING THEOREMS FOR CURRENTS. Wray, J. G. (Syracuse Univ., N. Y.). J. Math. Phys. (N. Y.), 9: 537-52(Apr. 1968).

The basic assumptions of the theory are strong unitarity, Bogoliubov causality, completeness of the in (out) fields on a unique vacuum, and Poincaré invariance. The algebra of Π functions, which are integral operators in the form of tempered distributions, is the main technical tool developed. These Π functions can be regarded as generalized step functions where the combination law is such that products with δ functions and their derivatives are well defined. An application of this algebra of Π functions in the context of the above assumptions leads to the current-formalism representations of nth-order functional derivatives of the current and S_{op}. These are alternatively called the R_P and P product representations, respectively, the counterparts to the R and Φ product representations of the nth-order derivative of the field and S_{op} in the field formalism. (auth)

44490 $S\tilde{O}(n)$: SYMMETRIC FIELD EQUATIONS. Bakri, M. M. (Cairo Univ.). Commun. Math. Phys., 9: 146-60(1968).

Field equations satisfied by the irreducible realizations of any inhomogeneous pseudo-orthogonal group are derived. For these representations which are characterized by the vanishing of the invariants of the inhomogeneous group, the field equations are of first order, of the form $S_{AB}p_B\psi = p_A\psi$. The possibility of considering $SO(q_1,q_2)$ as a higher symmetry group is discussed briefly. (auth)

44491 PARTICLE CREATION IN EXPANDING UNIVERSES. Parker, L. (Univ. of North Carolina, Chapel Hill). Phys. Rev. Lett., 21: 562-4(Aug. 19, 1968).

Results are reported of an investigation of elementary particle creation in expanding universes. (auth)

44492 CONNECTION BETWEEN FORMULATIONS OF GENERALIZED STATISTICS IN QUANTUM MECHANICS AND FIELD THEORY. Yamada, Mitsuru (Tokyo Univ.). Nucl. Phys., B6: 596-606(1968).

The two possible formulations of generalized statistics, i.e., formulations of quantum mechanics and field theory, are reviewed and criticized. Employing the representation theory of finite groups, the proof is given of the non-equivalence of these two formulations in the case of para-statistics for order $p \geq 2$. It is concluded that the arguments concerning the non-existence of para-particles which have so far been given by several authors are not applicable to the para-field theory. (auth)

44493 DAUGHTER REGGE TRAJECTORY IN A FIELD-THEORY MODEL. II. Swift, Arthur R. (Univ. of Massachusetts, Amherst). Phys. Rev., 171: 1466-74(July 25, 1968).

Secondary Regge trajectories obtained from a high-energy perturbation-theory treatment of ladder diagrams are compared with those obtained from numerical solutions of the Bethe-Salpeter equation and are found to be qualitatively identical. In particular, the trajectories intersect, become complex, then become real again, all below threshold; they are very model-dependent. However, ladder diagrams in relativistic field theory do not completely determine the secondary trajectories; the self-energy correction to the exchange particle propagator must be included. This modification of ladder diagrams completely eliminates the pathological behavior of the secondary Regge trajectories and the sensitive dependence on the parameters of the model. The first daughter becomes a nonintersecting, everywhere real, slowly rising function of the energy. The requirement that a field theory have well-behaved secondary Regge poles imposes nontrivial constraints on possible interactions. (auth)

Gravitation and General Relativity

Refer also to abstracts 43749, 43759, 43822, 44488, and 44491.

44494 ANGULAR MOMENTUM AND THE KERR METRIC. Cohen, Jeffrey M. (Goddard Space Flight Center, New York). J. Math. Phys. (N.Y.), 9: 905-6(June 1968).

For Kerr's rotating metric, it is shown that -ma is the angular momentum of the body where m is the mass and a is the rotation parameter. This is true even for large m and a. (auth)

44495 SOME TOTAL INVARIANTS OF ASYMPTOTICALLY FLAT SPACE-TIMES. Winicour, J. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). J. Math. Phys. (N.Y.), 9: 861-7 (June 1968).

The total energy, momentum, supermomentum, and angular momentum of asymptotically flat space-times are calculated in terms of coordinate and conformally invariant expressions by taking the limit in an invariant way of the asymptotic symmetry linkages through a sequence of finite closed two-spaces which converge to a sphere at null infinity. The resulting expressions consist of integrals over the sphere at null infinity of coordinate and conformally invariant quantities. In the case of energy and momentum these integrals may be reduced to expressions previously proposed by Penrose. (auth)

44496 GLOBAL EXISTENCE OF SPIN STRUCTURES FOR GRAVITATIONAL FIELDS. Bichteler, Klaus (Southwest Center for Advanced Studies, Dallas). J. Math. Phys. (N.Y.), 9: 813-15 (June 1968).

The notion of a spin structure for a gravitational field is defined, and it is shown that a spin structure exists if and only if the second Stiefel–Whitney class of the space–time M vanishes. The number of different spin structures is then equal to the number of elements in $H^1(M,Z_2)$. (auth)

44497 SPETSIAL'NAYA I OBSHCHAYA TEORIYA OTNOSITEL'NOSTI. ISTORICHESKIE OCHERKI. (Special and General Theory of Relativity. Historical Review). Frankfurt, U. I. Moscow, Izdatel'stvo Nauka, 1968. 332p.

A historical review of special and general relativity theory is presented. Over two thousand references are given, and an author citation listing is included. (J.F.P.)

44498 SPECIAL RELATIVITY IN THE QUANTUM DOMAIN. Cohn, Jack (Univ. of Oklahoma, Norman). Amer. J. Phys., 36: 749-51(Aug. 1968).

The question is raised whether one can legitimately assume special relativity to be valid in the quantum domain. In partial answer to this query, it is demonstrated that, owing to the Heisenberg uncertainty relations, a very general type of detector is only able to resolve space time to a limited degree. To this same degree the notion of local simultaneity, which is basic to the special theory, is inexact. (auth)

44499 GRAVITATIONAL RADIATION IN AN EXPANDING UNIVERSE. Hawking, S. W. (Univ. of Cambridge, Eng.). J. Math. Phys. (N. Y.), 9: 598-604(Apr. 1968).

Asymptotic expansions are used to study outgoing gravitational radiation in an expanding, dust-filled Friedmann universe of negative curvature. It is found that the interaction with the matter modifies the "peeling-off" behavior. A quantity is defined which is interpreted as the total mass of the source and the disturbance, and which monotonically decreases as gravitational radiation is emitted. The group of coordinate transformations that preserve the asymptotic form of the metric and the boundary conditions is the same as the isometry group of the undisturbed Friedmann model. This may indicate that no physical significance attaches to the extra transformations of asymptotically flat space which are not contained in the inhomogeneous Lorentz group. (auth)

44500 INTERIOR SOLUTION IN GENERAL RELATIVITY. Whittaker, J. M. (Univ. of Sheffield, Eng.). Proc. Roy. Soc. (London), Ser. A, 306: 1-3(July 30, 1968).

Formulae are given for the field of a sphere of constant gravitational mass density. (auth)

44501 ON SOME POSSIBILITIES OF GENERALIZING THE LORENTZ GROUP IN THE SPECIAL RELATIVITY THEORY. Everett, C. J.; Ulam, S. M. (Los Alamos Scientific Lab., N. Mex.). J. Comb. Theory, 1: 248-70(Sept. 1966).

The possibility is suggested that without assuming the existence of a minimal quantity for a distance in space one could think of only a discrete set of possible distances which would, however, be infinite, with arbitrarily small values possible, e.g., a set of distances that are actually realizable forming a perfect nowhere dense set, topologically equivalent to the Cantor discontinuum. In the very small, in dimensions of the order of 10^{-13} or less, it is conceivable that there could be a different topological and algebraic model. Mathematically the possibilities of dealing with such a heterogeneous structure involve problems of stability and of the notions of isomorphism and automorphism. A brief discussion of the definitions, and examples of problems concerning such generalized stability are given. (J.F.P.)

44502 CANONICAL QUANTIZATION OF GRAVITATIONAL FIELD. Peres, Asher (Univ. of Maryland, College Park). Phys. Rev., 171: 1335-44(July 25, 1968).

The six dynamical variables $g_{mn}(x)$ are expressed in terms of three "coordinatelike" variables $y^A(x)$ and three invariant variables $\gamma^\alpha(k)$. The longitudinal constraints $R_n^0 + T_n^0 = 0$ imply the vanishing of the momenta canonically conjugate to the $y^A(x)$, and the only remaining constraint can be written invariantly in terms of the $\gamma^\alpha(k)$, their conjugate momenta, and the matter variables. The quantization of this fourth constraint then leads to a Schwinger-Tomonaga equation $i\delta\Psi/\delta\sigma = H[\sigma]\Psi$, whose solution yields a complete set of commuting observables for the gravitational field. For most applications, it is possible to select the initial hypersurface so as to get the much simpler equation $i\partial\Psi/\partial T = H\Psi$, where the dynamical variable T (which is a known functional of the metric and the matter variables at $t = 0$) plays the role of an "invariant time." (auth)

Scattering Theory

Refer also to abstract 44438.

44503 (JINR-E2-3933) A LOWER BOUND OF THE ELASTIC SCATTERING AT FIXED MOMENTUM TRANSFER II. Baluni, Varoujan; Nguyen Van Hieu (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 5p. Dep.

On the basis of axiomatic analyticity some lower bounds of the elastic scattering amplitudes for all finite momentum transfers are established. (auth)

44504 PROPERTIES OF MANDELSTAM CUTS. Olive, D. I.; Polkinghorne, J. C. (Cambridge Univ., Eng.). Phys. Rev., 171: 1475-81(July 25, 1968).

The properties of Mandelstam cuts are discussed which can be deduced from expressions suggested by Feynman integrals together with an understanding of the singularity structure of real integrals. The suggestion of Schwarz about their "switching on and off" properties is confirmed, and some expressions for discontinuities are elucidated. The existence of a pole singularity underneath the Reggeon-particle and normal threshold cuts is demonstrated, and the importance of its role in eliminating the Gribov–Pomeranchuk essential singularity is emphasized. This property is also explored in terms of the Feynman-integral model, and the dangers and subtleties of calculations based on orders of the third spectral function are exhibited. (auth)

44505 SINGULARITIES OF A BETHE–SALPETER AMPLITUDE. Green, H. S.; Biswas, S. N. (Univ. of Adelaide). Phys. Rev., 171: 1511-16(July 25, 1968).

The Bethe-Salpeter equation for the scattering of two particles of unequal mass is reduced to separable form by the use of the bipolar transformation. Exact solutions are obtained for Wick's kernel, so that the S matrix and the Regge trajectories are explicitly determined. The daughter trajectories are identified for this kernel and are found to be related in the expected way with one another. It is shown that they make no contribution to the scattering amplitude on the mass shell. Trajectories are found corresponding to the abnormal solutions of Wick's equation, but these do not appear in the normal scattering amplitude. (auth)

44506 COMPLEX ANGULAR MOMENTUM AND INFINITE HELICITY SUMS. II. Winbow, G. A. (Cambridge Univ., Eng.). Phys. Rev., 171: 1517-22(July 25, 1968).

Some features of the continuation to complex total angular momentum of the three-particle discontinuity of a "double box" Feynman diagram are discussed. A solution of this problem implies that the discontinuity satisfies the bound required by Carlson's theorem. It is concluded that for this to be possible the phase-space integral has to be organized in two separate pieces. Also, the partial-wave amplitudes have to be broken into two separate pieces, each piece being given by a Froissart-Gribov contour around a singularity of the helicity amplitude. This splitting of the partial-wave amplitude introduces an extra singularity, but this does not contribute to the final expression. (auth)

44507 CALCULATION OF SOME THREE-BODY SCATTERING AMPLITUDES. Schlessinger, L. (Univ. of California, Berkeley. Univ. of Illinois, Urbana). Phys. Rev., 171: 1523-7(July 25, 1968).

Using a method based on numerical analytic continuation, S-wave, three-body, bound-state, elastic scattering amplitudes are calculated for both Coulomb (electron-hydrogen) and short-range potentials. In the calculations one particle is taken to be infinitely heavy, and only the spherically symmetric portion of the S-wave amplitude is considered. (auth)

44508 HANKEL INTEGRAL TRANSFORM OF THE SCATTERING AMPLITUDES. Arushanov, G. G. (Inst. of Nuclear Research, Tashkent). Dokl. Akad. Nauk Uzb. SSR, No. 2, 17-20 (1968). (In Russian).

Properties of Hankel integral transforms of scattering amplitudes are analyzed. (R.V.J.)

44509 NECESSITY OF N-PARTICLE PRODUCTION AMPLITUDES. Cheung, F. F. K. (State Univ. of New York, Stony Brook). Phys. Lett., 27B: 302-5(Aug. 5, 1968).

A nonvanishing N-particle production amplitude is shown to be a necessary consequence of the basic principles of S-matrix theory such as relativistic invariance, causality, crossing and unitarity relations. (auth)

44510 VARIATIONAL PRINCIPLES FOR CROSSING-SYMMETRIC OFF-SHELL EQUATIONS. Haymaker, Richard W.; Blankenbecler, R. (Univ. of California, Santa Barbara). Phys. Rev., 171: 1581-7(July 25, 1968).

Variational principles for the vertex function and the two-body scattering amplitude are constructed, based on crossing-symmetric dynamical equations. Our expressions are stationary under variations of all the trial functions that enter. All relevant channels are treated in a manifestly symmetrical manner. (auth)

44511 REGGE POLES FOR SPINLESS PARTICLES IN THE BACKWARD DIRECTION. Paschos, Emmanuel A. (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 171: 1620-6(July 25, 1968).

A new Regge representation is introduced which involves Legendre functions of a modified argument. The analytic and asymptotic properties of the new partial waves are studied. It is shown that the new representation is valid in extended regions of the Mandelstam plane where the background integral converges. In these regions the new representation explicitly possesses the correct analyticity in the new plane corresponding to the $\cos\theta_\mu$ plane. In regions of the Mandelstam plane where the conventional Regge representation is also valid, the new partial waves can be related to the conventional Regge poles. The compatibility of the results with those of other groups is discussed. (auth)

44512 NATURAL ZEROS OF REGGE RESIDUES. Jones, H. F.; Scadron, M. D. (Imperial Coll. of Science and Tech., London). Phys. Rev., 171: 1809-10(July 25, 1968).

The method of Reggeization of invariant amplitudes is discussed with particular reference to the kinematic zeros of the residue functions at nonsense points in J and at t = 0. The zeros which occur naturally at these points yield in the first case the sense-choosing solution, and in the second case a well-defined scheme covariant evasion, for satisfying the t = 0 conditions on helicity amplitudes. Factorization is automatically satisfied in our method. (auth)

44513 TWO SIMPLE APPROXIMATION SCHEMES FOR LIPPMANN–SCHWINGER-TYPE EQUATIONS. Balazs, L. A. P.; Patil, Sharashchandra H. (Univ. of California, Los Angeles). Phys. Rev., 171: 1633-42(July 25, 1968).

A pair of simple approximation schemes is proposed for generalized Lippmann-Schwinger equations. The equation is first reduced to the nonsingular Noyes form; this is essentially an equation for the "form factor" which takes the external particles off the shell. In the first scheme, a pole approximation is then made for the form factor. The parameters are determined by expanding the Noyes equation about the on-shell point. The method is applied in $\pi\pi$ scattering to the Logunov-Tavkhelidze equation, which was shown by Blankenbecler and Sugar to be an approximation to the Bethe-Salpeter equation. In addition to the form-factor method, these equations were also investigated using an extension of the Pagels approximation. Possible applications to the Bethe-Salpeter equation are discussed. (auth)

44514 CONVERGENCE OF A BORN SERIES. Corbett, John V. (Univ. of California, Davis). Contract AT(11-1)-Gen-10. J. Math. Phys. (N.Y.), 9: 891-8(June 1968). (UCD-CNL-80).

Three types of Born series which can be associated with a transition amplitude are discussed, and the criteria for the convergence of the different series are compared. With regard to the divergence of the Born series, the ordering: matrix-element series diverges implies vector series diverges implies operator series diverges, is obtained for the natural vector and operator Born series that can be abstracted from the expression for the transition amplitude. The conclusion that the divergence of the operator Born series does not ensure that the Born series of physical matrix-elements divergences is applied to an example of three-body rearrangement scattering. (auth)

44515 EXACT QUANTIZATION CONDITIONS. Rosenzweig, C.; Krieger, J. B. (Polytechnic Inst. of Brooklyn). J. Math. Phys. (N.Y.), 9: 849-60(June 1968).

The method of Froman and Froman for proving exact quantization conditions is reviewed. This formalism, unlike the usual WKB approximation to which it bears a close resemblance, requires consideration of the behavior of the potential everywhere it is defined. This approach leads to proofs that certain quantization conditions are exact without having to compare the results to solutions of the Schrödinger equation obtained by other means. Using the formalism, the correctness of all previously known exact quantization rules for the one-dimensional and radial cases is proven. Furthermore, it is shown that exact quantization rules can be proved for two other potentials. For one of these, no analytic solutions to the Schrödinger equation are known. For the latter case, the proof is checked by numerical integration of the Schrödinger equation for a special case. (auth)

44516 EXTENSION OF THE CONTOUR-DISTORTION METHOD IN RELATIVISTIC THREE-PARTICLE SCATTERING. McCartor, G. D.; Nuttall, J. (Texas A and M Univ., College Station). Phys. Rev., 171: 1627-33(July 25, 1968).

The results of a previous paper, showing how to relate the physical three-baryon scattering amplitude to the solution of a generalized Bethe-Salpeter equation with a nonsingular kernel, are extended to include c.m. energies up to the threshold for production of a meson. The distorted contours that are involved for each term of the perturbation expansion are no longer topological products of identical contours in the space of each complex four-momentum, and the final integral equations are more complicated than before. (auth)

44517 CURRENT FORMALISM. II. THE S MATRIX IN PERTURBATION THEORY. Wray, J. G. (Syracuse Univ., N. Y.). J. Math. Phys. (N. Y.), 9: 552-70(Apr. 1968).

In the context of asymptotic quantum field theory the following objectives were accomplished. The S-matrix equations of Pugh [R. E. Pugh, Ann. Phys. (N. Y.), 23: 335(1961)] and their generalization in the manner of Chen [T. W. Chen, Ann. Phys. (N. Y.), 42: 476(1967)] are derived without the aid of an interacting field. A diagrammatic representation of these integrodifferential equations is demonstrated. The problem of boundary conditions for a self-interacting system is solved in perturbation theory. This leads to a finite, divergence-free, no-cutoff expansion in the physical coupling constant. For renormalizable interactions, the only additional parameter is the physical mass, whereas for nonrenormalizable interactions, uniqueness of the expansion requires additional parameters with increasing order of expansion. The success of the perturbation expansion serves as a *posteriori* justification of the formulation in CF.I., [J. G. WrSy, J. Math. Phys., 9: 537(1968)]. The Π or "generalized step" function and its associated algebra play the principal technical role. The crucial Π-ordering relations and theorems developed in CF.I. are reviewed. (auth)

44518 SCREENING IN THE SCHROEDINGER THEORY OF SCATTERING. Dollard, John D. (Univ. of Rochester, N. Y.). J. Math. Phys. (N. Y.), 9: 620-4(Apr. 1968).

The time-dependent Schroedinger theory of scattering is studied rigorously with the potential V(x) replaced by $e^{-\epsilon|x|}V(x)$. Sufficient conditions are given that the Møller wave matrices $\Omega\pm$ be obtainable from this theory as $\epsilon \to 0$. The conjecture that this theory can be used to define a reasonable S matrix when the $\Omega\pm$ do not exist is false for the Coulomb potential. (auth)

44519 GENERALIZED SCATTERING AMPLITUDES FOR COVARIANT AND LOCAL UNSTABLE PARTICLES. Lukierski, J. (Univ. of Wroclaw). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys., 16: 431-6(1968).

If one accepts the fact that free unstable particles are described by generalized free fields with continuous mass spectrum, there is a possibility of defining the scattering amplitudes for unstable particles by means of the off-shell S-matrix elements. In the formulation of the basic postulates the functional formalism developed by Rzewuski is used. It is found that by suitable generalization of the Rzewuski formulation one can define the generalized S-matrix describing all scattering amplitudes involving stable and unstable states as outgoing and ingoing states. The four-dimensional mass-shell condition for free unstable particles is given, the multiplication of functionals is defined, the physical interpretation of the off-shell S-matrix elements by packets is introduced, and the set of three basic postulates of the S-matrix theory is also defined. (J.F.P.)

44520 PERIPHERALITY OF MULTIPLE PRODUCTION PROCESSES. Krzywicki, A. (Ecole Polytechnique, Paris. Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nucl. Phys., B6: 554-6(1968).

Strong dependence on momenta of secondaries of the phases of amplitudes for production processes has been recently uncovered. It may be interpreted as reflecting the fact that secondaries are, classically speaking, created on peripheral trajectories. (auth)

44521 INFINITELY RISING, NONLINEAR REGGE TRAJECTORIES. Kugler, M. (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Rev. Lett., 21: 570-2(Aug. 19, 1968).

By projecting s-channel partial waves from a t-channel Regge trajectory, families of resonances obeying $l \sim \sqrt{s}$ are obtained. It is proposed that these are Regge trajectories obeying $\alpha \sim \sqrt{s}$ for high s. (auth)

44522 MULTI-REGGEON MODEL AND POMERANCHUK EXCHANGE. Polkinhorne, J. C. (Cambridge Univ., Eng.). Nucl. Phys., B6: 441-8(1968).

It is shown that when the multi-Reggeon model takes account of mixed inelastic events (that is, events in which groups of particles are emitted traveling together with low relative momenta) a consistent picture, free from paradox, can be made based on Pomeranchuk exchange. The effect of unitarity on Mandelstam cuts is also evaluated and it is suggested that it leads to a softening of the asymptotic behavior associated with the cut by a factor (log log s)$^{-2}$. (auth)

44523 LORENTZ POLES IN EQUAL-MASS SCATTERING FROM ANALYTICITY AND FACTORIZATION. Bronzan, J. B.; Jones, C. Edward (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Lett., 21: 564-6(Aug. 19, 1968).

It is shown, by means of factorization, that the daughter Regge trajectories implied by analyticity in unequal-mass scattering amplitudes constitute a single Lorentz pole when they couple to an equal-mass channel. At zero energy the equal-mass elastic amplitude has the form const × $D_{-\alpha(0)-2}^{1}(-z)$. (auth)

44524 TIME DELAY OF SCATTERING PROCESSES. Agudin, Jorge L. (CNEA, Rio Negro, Argentina). Phys. Rev., 171: 1385-7(July 25, 1968).

It is shown that Smith's formulation of the collision lifetime matrix can be applied to the relativistic steady-state solutions of Maxwell's equations for the total-reflection case. In this way, a delay time Δt is obtained which, though probably unobservable as a time process ($\Delta t \sim 10^{-15}$ sec), leads to measurable results in a suitable stationary experiment. By multiplying the delay time Δt by the group velocity of the wave in the vacuum, the displacement Δx of the wave in the vacuum parallel to the surface is obtained. If the incident wave is then collimated by a slit, the center of the reflected beam, on reappearing in the dielectric, will show a parallel displacement relative to the beam reflected at the mirror which is given by $\Delta x_{||} = (\lambda/\pi)\,[(\sin\theta_i)/(\sin^2\theta_i - 1/n^2)^{½}]$, where λ is the wavelength of the light in the dielectric of refractive index n, and θ_i is the incident angle, greater than or equal to the critical one. This is just the result of the experiment performed as early as 1947 by Goos and Hänchen, who found the parallel displacement to be given by $(\Delta x_{||})_{exp} = 0.52\lambda[1/(\sin^2\theta_i - 1/n^2)^{½}]$. (auth)

Particle Accelerators

Refer also to abstracts 42999, 43124, 43310, 43924, 44371, and 44753.

44525 (ANL-Trans-647) CORRECTION OF THE AZIMUTHAL GRADIENT ERRORS IN A STRONG FOCUSING SYNCHROTRON. Balbekov, V. I.; Shukeilo, I. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from report IFVE-SKU-67-65K. 5p. Dep. CFSTI.

Some features of the gradient correction in a strong focusing synchrotron are investigated. The system for independent correction of the radial and vertical gradient stop-bands is described. (auth)

44526 ANL-Trans-653) ADJUSTMENT OF ACCELERATION CONDITIONS AND BEAM PARAMETERS OF THE LINEAR ACCELERATOR I-2. Batalin, V. A.; Kapchinskii, I. M.; Lazarev, N. V.; Plotnikov, V. K.; Polyakov, B. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from report ITEF-513. 17p. Dep. CFSTI.

A linear strong-focusing proton accelerator was put in action in the Institute for Theoretical and Experimental Physics. A 24.6-MeV proton beam with a pulsed current up to 130 ma was obtained. The methods of starting, the operations used for the beam intensity increase as well as the characteristics of the beam and the conditions of linac are given, and the instruments used for the beam measurements are described. (auth)

44527 (BNL-12493) MODULATOR APPLICATIONS IN HIGH-ENERGY ACCELERATORS. Forsyth, E. B. (Brookhaven National Lab., Upton, N. Y.). [1967]. 8p. (CONF-680520-3). Dep. CFSTI.

From 10th Modulator Symposium, New York.

Modulator-type circuits used in accelerators operating in the GeV range are briefly described. The operation of high-energy synchrotrons and linear accelerators is outlined, and a list of existing accelerators which produce particle beams of 1 GeV and greater is included. (W.H.K.)

44528 (BNL-12690) ACCELERATOR DESIGN USING CONSTANT GRADIENT SUPERCONDUCTING MAGNETS. Forsyth, E. B. (Brookhaven National Lab., Upton, N. Y.). July 10, 1968. 21p. Dep. CFSTI.

The design of an accelerator which attempts to use the existing characteristics of superconducting magnets is presented. A 1-GeV accelerator using these principles turns out to be a weak-focusing fast-cycling synchrotron. As such it could be used as a relatively low cost meson factory, though the design is not sufficiently advanced for a cost analysis. Several problem areas have appeared, particularly low energy stability and ejection at final energy. It is clear that the simple gradient field proposed cannot be achieved in practice and, indeed, further analysis may indicate modifications which would lead to an improved accelerator. An example is the incorporation of alternating gradient ridges in the field to improve the focusing properties. However, the basic principle of a superconducting magnet reflecting field will remain the same. (auth)

44529 (BNL-12691) LINE HARMONICS AT THE AGS. Forsyth, E. B. (Brookhaven National Lab., Upton, N. Y.). July 8, 1968. 24p. Dep. CFSTI.

Reasons and possible solutions for the harmonic components present on the voltage waveform of the power feeder for the AGS are given. The results of tests using a model filter trap are also given. The filter described is capable of producing significant reduction in the line voltage distortion experienced on the AGS feeder; also the filter allows a 15 to 20% increase in current at distribution points to which it is connected. (tr-auth)

44530 (CERN-68-22) BEAM STACKING WITH SUPRESSED BUCKETS IN THE ISR. Ruggiero, A. G. (European Organization for Nuclear Research, Geneva (Switzerland)). June 4, 1968. 39p. Dep.

The process of accumulating a beam in the CERN Intersecting Storage Rings (ISR) by radio-frequency stacking with suppressed buckets at $\Gamma = 0.50$ and at $\Gamma = 0.84$ was investigated on a computer. The stacking efficiency was calculated for several values of the number of the suppressed buckets. The results show that within the statistical error, the stacking efficiency does not depend on the number of suppressed buckets provided one always injects such a number of pulses that the total numbers of stacked buckets are equal. (auth)

44531 (CERN-68-27) EQUIVALENT CIRCUIT ANALYSIS OF PHASE-LOCK BEAM CONTROL SYSTEMS. Schnell, W. (European Organization for Nuclear Research, Geneva (Switzerland)). July 17, 1968. 59p. Dep.

Phase-lock beam control systems refer to all synchrotron rf systems in which the phase of the circulating bunches of particles is detected by means of an induction electrode and made to control the phase or frequency of the accelerating cavities. The transmission of phase information from the induction electrode to the cavity can be done by an open-loop chain or by a closed-loop servo system. Phase-lock systems of all kinds are analyzed using equivalent circuits. (W.H.K.)

44532 (CERN-68-29) PARTICLE SEPARATION WITH TWO- AND THREE-CAVITY RF SEPARATORS AT CERN. Bernard, P.; Lazeyras, P.; Lengeler, H.; Vaghin, V. (European Organization for Nuclear Research, Geneva (Switzerland)). 1968. 62p. Dep.

The principle of operation of the two- and three-cavity separator (Schnell-type separator) is described, and the momenta regions where one- and two-particle rejection is possible are computed. In the two-cavity separator, two-particle rejection is possible only in some very small momenta regions, whereas in the three-cavity separator it is possible over a large continuous momentum range. For the CERN three-cavity separator (total intercavity distance 50 m, frequency 2855 MHz) it is found that separation of kaons and pions is, in principle, possible between 7 and 16 GeV/c, and for antiprotons between 7 and 18 GeV/c. The rf separated beam (u_3 beam) for the CERN 2 m hydrogen bubble chamber is described briefly, and its main parameters are given. It can work as a separated and unseparated beam up to 20 GeV/c with a minimum momentum bite $\Delta p/p = \pm 0.25\%$ and a maximum solid angle at the target $\Delta\Omega = 150\ \mu sr$. As the pulse length of the RF separator does not exceed 8 μsec, it must be used in conjunction with a fast-ejected proton beam from the CERN Proton Synchrotron (CPS). An external target ($2 \times 1\ mm^2$ cross-section) allows one to use secondaries produced under 0°. In order that contamination of the separated beam by unwanted hadrons at the bubble chamber be decreased to below a few per cent, the beam stopper thickness has to be made about 2.5 times the size of the undeflected beam. The final deflection of wanted particles maximizing the wanted particle flux at the bubble chamber turns out to be four times the (vertical) angular opening of the undeflected beam in the centre of the deflectors. A short description of the technical layout is given. Up to now, the whole system has accumulated about 3500 hours of running-time with a failure rate below 1%. Our phase comparison system behaved remarkably stably even without temperature stabilization of the reference phase cable. This was found from periodic checks of the beam composition behind the beam stopper over several hundred hours of operation. The tuning of the two- and three-cavity separators can be done in a few hours and is described in detail. More than 2 million bubble chamber pictures have been taken with the separator, of which 100,000 were taken with the three-cavity separator. In all cases the contamination by unwanted hadrons was pushed below a few per cent. Under the most unfavorable working conditions about 100,000 unwanted hadrons had to be rejected by the separator for one wanted hadron in the bubble chamber. In some cases the muon contamination presented a serious problem, but it was found that longer collimators and more shielding in front of the bubble chamber reduce this background substantially. From experimental results it was concluded that under actual CPS working conditions the following upper limits for RF separation can be expected: $K^{\pm}$: 14-16 GeV/c, $\bar{p}$: ~13 GeV/c, and π^{+}: 16-18 GeV/c. The lower limit of separation is mainly due to the muon contamination; it probably lies below 7 GeV/c. Finally, the tolerances and fluctuations of various parameters affecting the separation are discussed, and numerical values are given. (auth)

44533 (CERN–68-30) ON THE DESIGN OF DISC-LOADED WAVEGUIDES FOR RF SEPARATORS. Bernard, P.; Lengeler, H.; Vaghin, V. (European Organization for Nuclear Research, Geneva (Switzerland)). July 22, 1968. 44p. Dep.

Some aspects of the deflecting hybrid mode in disc-loaded waveguides are considered. This study was initiated by the fact that, in the CERN RF separator, breakdown troubles appeared in the deflectors far below the maximum power of 20 MW delivered by the klystron amplifiers (Thomson Varian TV-2011). Therefore the problem of limiting power P_p is carefully considered. It is assumed that the breakdown level is determined mainly by the peak electric field E_p on the metal surface and that therefore the parameter E_p/E_o can be applied to arrive at an estimation of P_p (where E_o is equivalent deflecting strength). From power tests in CERN deflectors (λ = 10.5 cm) the absolute value of E_p is found to be 522 kV/cm at pulse duration τ = 1 μsec. It turned out that the locations of the breakdowns on the disc surface coincide with the points corresponding to the location of E_p as determined from cold measurements. For the dependence of the values E_p and P_p on the pulse duration a law $E_p \sim \tau^{-1/4}$ and $P_p \sim \tau^{-1/4}$ is found. Since at present the E_p/E_o parameter cannot be calculated, a method of measurement was developed and is described. The results of these measurements for the modes $\pi/2$, $2\pi/3$, and $4\pi/5$ with different disc thickness are presented in a systematic form. On the basis of these results the estimation of the limiting power for the modes $\pi/2$, $2\pi/3$, and $4\pi/5$ with different disc thickness is made. A scheme of optimization of the deflector parameters is outlined and applied to the CERN RF beam. The optimized parameters for the new CERN deflectors are given and compared with the old ones. (auth)

44534 (HMI-B–55) PHASE SPACE COMPRESSION IN CIRCULAR ACCELERATORS AND STORAGE RINGS. Biersack, J. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). Dec. 1967. 46p. (In German). Dep.

A new derivation of the equations of motion is given for charged particles in the rf field of a circular accelerator. The cases, which yield nonhamiltonian equations of motion, are studied with respect to a compression of phase space. Such a possibility occurs if there exists an energy loss due to radiation or a radius-dependent rf voltage in addition to some energy loss (e.g., radiation) or gain (e.g., betatron field). It is shown that in the second condition the compression is much more significant than in the first. The effect on the examples of a betatron-synchrotron and of an electron storage ring is illustrated. The radial perturbation of the orbit, which is an inevitable side effect of the radius-dependent rf voltage, is examined. (auth)

44535 (IFVE-SKU–67-35-K) CONCERNING THE CROSSING OF PARAMETRIC RESONANCE IN ACCELERATORS WITH INTENSIVE BEAMS. Balbekov, V. I.; Shukeilo, I. A. (Institut Fiziki Vysokikh Energii, Serpukhov (USSR)). 1967. 21p. (In Russian). Dep.

A growth of betatron oscillations in cyclic accelerators is investigated when the betatron number is crossing the line of parametric resonance due to Coulomb interaction of particles. A dependence of the charge density on the particle position in a bunch results in a multiple crossing of the resonance. The approximate solution of the equation of betatron oscillations is obtained and the particle losses are calculated. The general theory is illustrated by calculations for the Serpukhov 70 GeV proton synchrotron. (auth)

44536 (IFVE-SKU–67-44-K) THE TOPOGRAPHY OF THE MAGNETIC FIELD IN THE OPEN AND CLOSED UNITS OF THE ELECTROMAGNET OF THE 70 GeV ACCELERATOR. Glukhov, Yu. S.; Korol'kov, I. Ya.; Kuznetsov, I. K.; Kuz'min, V. F.; Lednev, A. A. (Institut Fiziki Vysokikh Energii, Serpukhov (USSR)). 1967. 63p. (In Russian). Dep.

The magnetic field topography in the open and closed units of the ring magnet of the 70-GeV proton synchrotron at three induction levels is given. Measuring apparatus is described in brief. (auth)

44537 (INR-P–893/XVIII/PP) LABORATORYJNE DZIALO ELEKTRONOWE: 50 kV. KONSTRUKCJA DZIALA I POMIARY PARAMETROW WIAZKI ELEKTRONOWEJ. (Laboratory Electron Gun: 50 kV. The Construction of the Gun and Measurements of Parameters of Electron Beam). Jakubowski, Lech; Skladnik-Sadowska, Elzbieta (Institute of Nuclear Research, Warsaw (Poland)). 1968. 31p. (In Polish). Dep.

A detailed description is presented of the construction of a laboratory electron gun which ensures a beam current about 15 mA with an extraction voltage of 50 kV and with a magnetic focusing. The most advantageous parameters and operational characteristics of the gun are established. By means of static and dynamic methods the shape and convergence of the electron beam as well as current density distributions over the beam cross-section were investigated. Determined on the basis of those measurements the minimum cross-over was equal 0.1 mm at the beam current 100/uA. For the greater currents (up to some mA at the voltage 15 kV) the average current density amounted to 25 mA/mm^2 in the cross-over of diameter about 0.5 mm. (auth)

44538 (JPRS–46039) PRINCIPLES OF AUTOMATIC CONTROL INCREASE OF ACCELERATOR ENERGY. Mints, A. L. Translated from Priroda, No. 4, 8-15(1968). 14p. CFSTI.

The development of high-energy accelerators is outlined. Fundamental principles of proton accelerators, strong focusing (AG), automatic control of parameters, cybernetics and accelerators, design parameters of a 1-TeV accelerator, principles of automatic control, and a 1-GeV cybernetic accelerator model are discussed. (W.H.K.)

44539 (NAL–11-0100) INJECTION ACCUMULATOR NAL PROTON SYNCHROTRON. Wilson, R. R. (National Accelerator Lab., Batavia, Ill.). May 13, 1968. 21p. Dep. CFSTI.

This technical work on an injection storage ring (accumulator) for use with the 200-GeV NAL proton synchrotron is described. Storage ring parameters, magnet structure, beam transfer, and design changes are discussed. (W.H.K.)

44540 (NAL–12-0100) EARLY HISTORY OF THE 200-GeV ACCELERATOR. Linvingston, M. Stanley (National Accelerator Lab., Batavia, Ill.). June 18, 1968. Contract AT-(49-8)-3000. 30p. Dep. CFSTI.

An account is given of the background, origins, and initial organization of the National Accelerator Laboratory, covering its work through the beginning of 1968. The early technical work is described concerning the 200-GeV proton synchrotron proposal. (auth)

44541 (RHEL/R–152) EFFECT OF HIGH-ENERGY RADIATION ON THE MECHANICAL PROPERTIES OF EPOXY RESIN SYSTEMS USED FOR PARTICLE ACCELERATOR CONSTRUCTION. Sheldon, R.; Stapleton, G. B. (Rutherford High Energy Lab., Chilton (England)). Jan. 1968. 44p. UK 6s. 0d.

An evaluation of epoxy resin–glass fabric composite materials for use in nuclear environments is presented. The changes in mechanical properties of these materials with respect to absorbed radiation dose are given. The results indicate that choice of resin system and glass fabric coupling agent have considerable bearing on the post-irradiation strength of these materials; differences between systems of more than a factor of 10 are demonstrated following similar radiation doses. (auth)

44542 (SLAC–87) TWO-MILE ACCELERATOR PROJECT. Quarterly Status Report, October 1–December 31, 1967. (Stanford Linear Accelerator Center, Calif.). June 1968. Contracts AT(04-3)-400; AT(04-3)-515. 52p. Dep. CFSTI.

Operations and development of the 20-GeV electron Stanford Linear Accelerator are described. Topics discussed include system and component performance, accelerator physics, klystron studies, mechanical engineering and fabrication, instrumentation and control, electronics engineering, counting electronics, spectrometer program, energy absorbers, and power supplies. (W.H.K.)

44543 (UCRL–18211) STUDY OF THE REGENERATIVE EXTRACTOR OF THE BERKELEY 184-INCH-SYNCHROCYCLOTRON. Paul, Arthur C. (California Univ., Berkeley.

Lawrence Radiation Lab.). Apr. 24, 1968. Contract W-7405-eng-48. 55p. Dep. CFSTI.

The behavior of the regenerative extractor of the Berkeley 184-inch cyclotron has been studied by separating the properties of the incident beam from the properties of the regenerator. This was accomplished by considering the extraction efficiency as the product of two quantities, the differential extraction efficiency determined by the magnetic field perturbations, and the phase space density determined by the quality of the beam incident upon the regenerator. The calculations are based on the study of some 1500 particles representing a sampling over energy (radial amplitude), radial betatron phase (azimuth of maximum radial amplitude), vertical betatron amplitude, and vertical betatron phase. The particles are started inside the stable region of the radial betatron phase space and accelerated through at least one complete precessional oscillation (40-100 revolutions) before gaining sufficient energy to cross the separatrix of the phase space diagram and begin regeneration. During this precessional revolution they sample entry into the regenerator without extraction. Once outside the stable region, regeneration sets in with the cessation of the radial betatron precession. Five distinct mechanisms of particle loss have been found associated with the beam extraction system. Mode 1—axial growth and subsequent vertical loss of the low energy beam penetrating into the regenerator field but not deep enough for the onset of regeneration; Mode 2—resumption of radial precession during regeneration, resulting in vertical loss of the beam or exit from the magnetic field at the wrong azimuth; Mode 3—successfully regenerated beam failing to pass through the magnetic channel aperture; Mode 4—vertical loss of the successfully regenerated beam at $\nu_z = 1/2$ by overfocusing in the last several turns in the rapidly falling fringing field of the cyclotron (peeler field); and Mode 5—mismatch between the phase space acceptance of the external beam and the emittance of the beam leaving the cyclotron. The relative importance of the various modes of loss depends on the betatron oscillation amplitudes and, hence, is determined by the quality of internal beam incident on the regenerator. The extraction efficiency for the 184-inch cyclotron is found to be dominated by the vertical beam growth at $\nu_z = 1/2$ and the radial width of the magnetic channel. The results of the computer study based on the measured magnetic field data of the 184-inch cyclotron have been verified by actual measurements carried out at the cyclotron. Favorable comparison has been obtained between predicted and measured values, including: 1) extraction efficiency, 2) dependence of extraction efficiency on the radial and vertical betatron oscillation amplitudes, 3) external beam energy; 4) external beam energy distribution, and 5) spacial beam profiles. The calculated extraction efficiency of 9% compares favorably with present machine operation. (auth)

44544 (UJV-1903) POLYNOMIAL EXPRESSIONS OF ELECTRIC AND MAGNETIC FIELDS INTENSITY IN A HORIZONTAL PLANE OF A CYCLOTRON. Grda, A.; Kuzmiyak, M. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Mar. 1968. 33p. (In Czech). Dep.

A polynomial expression was derived for the intensity of electric and magnetic fields in cyclotrons. General formulas, polynomial coefficients, approximating the course of electric field intensity, and Gier-Algol programming for polynomial coefficients which approximate radial intensity drop in cyclotron magnetic field, are given. The results of polynomial calculations for U-120 cyclotron are presented. The expressions obtained may be used for analysis of initial particle trajectories in a cyclotron and for implicit studies of particle kinematics in the cyclotron horizontal plane during the whole acceleration process. (tr-auth)

44545 ACCELERATORS FOR LAMINATED BEAMS. Muel, Jacques (Ecole Nationale Superieure, Grenoble, France). Ind. At., 12: No. 1-2, 43-51(1968). (In French).

One of the factors contributing to the industrial development of electron irradiation over large surfaces is the perfecting of apparatus better adapted for use. To produce without sweeping a sheet of accelerated electrons under some hundreds of kilovolts offers numerous advantages as compared with standard systems. Consequently, at the C.E.N. of Grenoble, a device was designed and constructed capable of producing a homogeneous laminar beam. Thereafter they developed a model which produces a beam of electrons 1,000 mm wide at 300 kV. Tests are being continued in collaboration with the Sames Company to perfect an industrial prototype accelerator with laminar beam. (auth)

44546 GLASGOW LINAC: AN ACCELERATOR FOR NUCLEAR STRUCTURE RESEARCH. Meas. Instrum. Rev., 15: 520-3(July 1968).

A description is given of the 100-MeV linear accelerator at the National Engineering Laboratory, East Kilbride, Scotland, built for the University of Glasgow. Details are given of the principles of operation, modulators, klystrons, r.f. drive, waveguides, electron gun, focussing coils, vacuum system, controls, positron facility, short pulse facility, and variable energy arrangements. The types of experiments envisaged are mentioned, together with possible extensions of the equipment. (UK)

44547 APPLICATION OF SUPERCONDUCTIVITY TO PARTICLE ACCELERATORS. Hirel, R. (Ecole Normale Superieure, Orsay, France). Onde Elec., 48: 595-600(June 1968). (In French).

Coefficients of overvoltage of superconducting cavities have been determined in respect of cylindrical cavities of accelerator system TM_{010}, 3,000 MHz, at a temperature of 4.2°K, on different types of electrolytic deposits of lead, in order to ascertain the improvement of overvoltage coefficients of a cavity according to the quality of the electrolytic deposit of lead. A study of the interaction of a beam of electrons with one of these superconducting accelerator cavities was carried out. (auth)

44548 CHROMATIC ABERRATIONS OF AN INVERSION QUADRUPLET. Lenormand, Jean-Michel (Faculte des Sciences, Rennes, France). Compt. Rend., Ser. A and B, 266: 1313-16(May 13, 1968). (In French).

It is shown that for a normal inversion quadruplet placed symmetrically with respect to the source and the image the best operational conditions from the viewpoint of transverse chromatic operations are those found previously in the study of the angular acceptance. The notations previously used are maintained and the calculations are limited to the case $P = Q = (L_1/2)$. (tr-auth)

44549 THROBBING BEAM TRANSVERSE RESISTIVE INSTABILITIES IN CIRCULAR ACCELERATORS AND STORAGE RINGS. Lee, Martin Joe. Stanford, Calif., Stanford Univ., 1967. 75p.

Thesis.

Finite conductivity of the vacuum chamber wall can cause unstable transverse oscillations of the center of charge or oscillations of the transverse cross section of a beam of charged particles. A study has been conducted of the cross-sectional oscillations of a nearly circular beam centered in a circular pipe, and a self-consistent solution has been obtained for both monopole and multipole oscillations. Dispersion relations for the oscillation frequencies have been found, and conditions for stability have been deduced. For multipole instabilities the growth rates and thresholds are close to those obtained for the dipole instability, differing only by a geometrical factor; whereas, for the monopole instability, the growth rates are so small that the oscillations in present accelerators and storage rings will be suppressed by the physical processes such as interaction with the residual gas, radiation damping, etc. In all cases, the growth rate is proportional to the number of particles in the beam and inversely proportional to the square root of the wall conductivity. It is shown that in the absence of Landau damping a longitudinally continuous beam is always unstable against the development of transverse waves having a phase velocity close to $(n - m\nu_0)\Omega R$ where ν_0 is the number of betatron oscillations per revolution, Ω is the revolution frequency, R is the radius of the machine, n is an integer greater than $m\nu_0$ with 2m the multipole number (m = 1 for dipole and m = 2 for quadrupole, etc.). (TSS) (Disser. Abstr.)

44550 SPUTTERING ION SOURCE FOR PRODUCING AN ION BEAM COMPRISING IONS OF A SOLID MATERIAL. Hill, Kenneth Jeffery; Nelson, Richard Stuart (to United Kingdom Atomic Energy Authority). U. S. Patent 3,393,339. July 16, 1968. Priority date July 13, 1964, Great Britain.

A sputtering ion source for producing an ion beam comprising ions of a solid material is described. A helically coiled d-c. energized filament is mounted in a low pressure gaseous atmosphere adjacent to and coaxial with an end surface of a first electrode formed of said material whereby electrons from the filament ionize the gas and the gas ions strike the electrode releasing atoms. These atoms are in turn ionized and the magnetic field of the filament tends to concentrate them on the axis. A further apertured electrode is provided to extract the ions thus concentrated on the axis and project them as a beam in a direction away from the first electrode. (auth)

44551 USE OF THE BETATRON FOR THE RADIOSCOPY OF THICK-WALLED OBJECTS IN THE URAL MACHINE WORKS. Knyazyuk, L. V.; Buzynov, A. E.; Gorpinchenko, G. K. Defektoskopiya, No. 2, 75-80(1968). (In Russian).

The installations in the betatron laboratory of the Ural Machine Works are described. Equations for the calculation of plant costs of the roentgenographic prints were proposed. The costs of the roentgenographic prints of a series of details are given. (tr-auth)

44552 ONE EFFECT IN THE BETATRON TARGET. Bulaev, O. F.; Gorbunov, V. I.; Grigor'ev, A. P. (Tomsk Polytechnical Inst., USSR). Defektoskopiya, No. 2, 68-70(1968). (In Russian).

During investigation of the focusing spots in the betatron target, the formation of two spots was detected. Considering the construction of the target and the fault rate of the accelerated electrons, it is assumed that both foci are formed because of the radial betatron oscillations and the electron dispersion in the target. It is concluded that with the use of a narrow target the horizontal dimension of the foci is determined by the width of the target. (tr-auth)

44553 100 MeV LINEAR ACCELERATOR INSTALLED AT GLASGOW UNIVERSITY. Engineer, 225: 920-2(June 14, 1968).

Functions of the accelerator are discussed, an experimental program is outlined, and performance details are tabulated. The site and ancillary services are described. Brief details are given of the modulators, klystrons, rf drive, accelerator wave guides, electron gun, and focus coils. Special features of the accelerator include the positron facility, which has achieved very high positron currents, the short pulse facility for very accurate flight measurement, and the variable energy which can range from 130 to <20 MeV. (UK)

44554 DESIGN OF A THIN FOIL-TYPE ELECTRON BEAM MONITOR FOR 6 MeV LINEAR ACCELERATOR. Tanooka, Hiroshi; Matsumoto, Ken (National Cancer Center, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 28: 169-77(May 1968). (In Japanese).

An electron beam monitor for a 6-MeV medical linear accelerator was designed for dosimetry at irradiation during beam centering. The monitor consisted of a metal foil which was inserted across the path of the electron beam to absorb a fraction of electrons and of a highly sensitive galvanometer. The galvanometer reading was calibrated against the Fricke dosimeter to obtain the absolute absorbed dose. Centering of the beam was controlled by the balance between electric currents given to divided foils of the beam monitor. Automatic switch-off control for electron irradiation with a pre-set dose was made possible by combination of the monitor with the current integrator. (auth)

44555 COULD WE BUILD POLARIZED PROTON STORAGE RINGS? Csonka, P. L. (CERN, Geneva). Nucl. Instrum. Methods, 63: 247-52(Aug. 15, 1968).

The importance of high energy polarization experiments, particularly with proton storage rings, is emphasized. It is suggested that strong interactions might be used to polarize proton beams, and three methods to achieve this are given. An order of magnitude estimate is given using the CERN-ISR as an example. The obtainable polarizations depend on the scattering parameters $L(S_a,S_b; S_c,S_d)$. An experiment is suggested to determine the most important combination of these. A positive result of that experiment alone could suffice to enable one to start detailed design studies. (auth)

44556 EXPANSION OF CYLINDRICAL BEAMS DUE TO SPACE-CHARGE EFFECTS WITH UNIFORM ACCELERATION. Hara, E. (Hitachi Central Research Lab., Tokyo). Nucl. Instrum. Methods, 63: 313-16(Aug. 15, 1968).

The expansion of cylindrical beams due to space-charge effects with uniform acceleration was first treated by Moss. Kuznetsov pointed out an incompleteness of Moss's treatment and gave some numerical graphs. More generalized formulae than that of Kuznetsov's are derived, and some important numerical graphs which permit obtaining profiles of cylindrical charged particle beams undergoing uniform acceleration are presented. (auth)

44557 INDICATOR FOR ION BEAM CROSS-SECTION. Nicholson, P. W. (Middlesex Hospital Medical School, London). Nucl. Instrum. Methods, 63: 357(Aug. 15, 1968).

A simple arrangement is described to enable the cross-sectional distribution of an ion beam to be continuously monitored. (auth)

44558 BEAM EXTRACTION SYSTEMS OF THE BUENOS AIRES 180-cm SYNCHROCYCLOTRON. Slobodrian, R. J. (Univ. of California, Berkeley). Nucl. Instrum. Methods, 63: 355-6(Aug. 15, 1968).

The beam extraction systems of the Buenos Aires 180-cm synchrocyclotron are succinctly described and compared. (auth)

44559 APPLICATION OF RUTHERFORD SCATTERING TO TARGET THICKNESS MEASUREMENTS. Burke, D. G.; Tippett, J. C. (McMaster Univ., Hamilton, Ont.). Nucl. Instrum. Methods, 63: 353-4(Aug. 15, 1968).

Alpha particles from a radioactive ^{241}Am source were scattered from thin foils and the count rate of scattered particles used to determine the foil thicknesses. The method is particularly suitable for targets of high atomic numbers which have been deposited on supporting foils of material with a low atomic number. (auth)

44560 PRECISION-CONTROLLED THYRISTOR POWER SUPPLIES. Dale, S. H.; Dugard, N. A.; Finney, D. (General Electric Co., Witton, Eng.). G.E.C. J. Sci. Technol., 35: 48-56 (1968).

Current-controlled thyristor power supply units of 52.5, 105, and 220 kW were designed for the beam magnets of the Nimrod synchrotron. A transformer provides the correct voltage for the thyristor-diode bridge-connected rectifier which controls the dc voltage. The output voltage from the rectifier is smoothed by a passive filter. The equipment is described and the results of testing are discussed. (UK)

44561 ELECTRON LOADING OF 1-MV VAN DE GRAAFF-TYPE POSITIVE-ION ACCELERATOR. Furuta, Junichiro; Hiraoka, Eiichi. Annu. Rep. Radiat. Center Osaka Prefect., 8: 89-91(1967).

The electron loading of Van de Graaff-type positive-ion accelerators is reported using a new acceleration tube. The beam loading effects are measured by detecting x-ray energies. The threshold of x-ray generation caused by electron loading disappears by short aging. Loading electrons are considered to be emitted from the acceleration electrodes by ion beam bombardment. (auth)

44562 2-GeV ELECTRON LINEAR ACCELERATOR OF THE PHYSICAL AND TECHNICAL INSTITUTE OF ACADEMY OF SCIENCE OF UKR. SSR. Beloglazov, V. I.; Bazaev, Yu. M.; Val'ter, A. K.; (and others). At. Energ. (USSR), 24: 540-5 (June 1968). (In Russian).

The 2 GeV electron linear travelling-wave accelerator is described. Some historic data on the development of high energy electron linacs at the Physical and Technical Institute of Academy of Science of Ukr. SSR are also presented. The main parts of the accelerator are outlined including the injector, accelerating system, pulsed RF power system, vacuum system, focusing system, beam observation, and steering systems. The main parameters of the accelerator are given. (auth)

44563 PARAMETERS OF THE EXPERIMENTAL QUADRUPOLE MAGNETIC LENS. Vaulin, L. N.; Doinikov, N. I.; Monoszon, N. A.; Nikiforovskii, A. V.; Popov, A. V.; Samsonov, G. N.; Strel'tsov, N. S. Prib. Tekh. Eksp., No. 3, 40-4(May-June 1968). (In Russian).

A method for determining the profile of the terminal of a quadrupole magnetic lens is described. The method is less sensitive to the effects of the saturation of iron. The results of the measurement for two different lenses, having modifications of the same type, were reported. The configurations of the forming profiles with rounded off angles, guaranteeing the compensation of the 6th and 10th harmonic in the decomposition of the components of the field voltage up to value of the product of the gradient at the half-aperture equal to $Ga_0 \approx 13$ to 14 kgauss, were found. In other cases the low values of the amplitude of the harmonic components were preserved down to values of $Ga_0 \approx 18$ kgauss. (tr-auth)

44564 COMPACT SOURCE FOR NEGATIVE OXYGEN IONS. Danilina, T. I.; Ivanova, E. V.; Kreindel, Yu. E.; Levshuk, L. A. (Tomsk Inst. of Radioelectronics and Electron Technology, USSR). Prib. Tekh. Eksp., No. 3, 158-61(May-June 1968). (In Russian).

On the basis of Penning-type discharges with cold cathodes and fixed magnets, a negative oxygen ion source was developed. The ion extraction was done through an opening in the anode surface perpendicular to the discharge axis. For an increase in the efficiency of the extraction and reduction of the electron charge of the extracting electrode, the magnetic field close to the emission opening was deformed by means of ferromagnetic anode inset and ferromagnetic extracting electrode. In stationary regime a stable current of negative ions of 50 μA is obtained by means of electron charge of 15 mA and oxygen consumption of 40 cm^3/hr. (tr-auth)

44565 SYSTEM FOR THE MEASUREMENT OF THE ENERGY SPECTRUM OF THE ELECTRON BEAM OF A LINEAR ACCELERATOR. Karas, V. L.; Makhnenko, L. A.; Skubko, V. A. (Physical-Technical Inst., Kharkov). Prib. Tekh. Eksp., No. 3, 34-7 (May-June 1968). (In Russian).

A system for the measurement of the energy spectrum of the electron beam at the output of a linear accelerator is described. This system provides visual display of the shape of the spectrum on an oscillograph, its recording and immediate reading of its half-width on an indicator. A brief analysis was given of the operation of the individual units and the results of tests on the accelerator at energy of 360 MeV were given. (tr-auth)

44566 HEAVY-DUTY COOLED RESISTORS FOR SHUNTING ACCELERATOR RESONATORS. Karliner, M. M.; Ostreiko, G. N.; Panasyuk, V. S.; Sedlyarov, I. K.; Shekhtman, I. A. (Inst. of Nuclear Physics, Novosibirsk, USSR). Prib. Tekh. Eksp., No. 3, 38-40(May-June 1968). (In Russian).

The possibility of reducing the leakage of the pulse power in commercial resistors, used as equivalent high-frequency loads and for shunting heavy-duty accelerator resonators, was examined for the purpose of expanding the pass band during frequency modulation. A method was described for the measurement of the pulse high-frequency power supply by heating with pulses from the resistor. (tr-auth)

44567 INSTALLATION FOR THE INVESTIGATION OF THE INTERACTION OF ELECTRON AND PHOTON BEAMS WITH ENERGY UP TO 2 GeV WITH NUCLEI AND NUCLEONS. Afanas'ev, N. G.; Gol'dshtein, V. A.; Dementii, S. V.; Evlanov, O. V.; Yaroshevskii, L. D.; Arkatov, I. M.; Stepula, E. V.; Denyak, V. M.; Korba, M. P.; Vlasenko, V. G. (Physical-Technical Inst., Kharkov). Prib. Tekh. Eksp., No. 3, 30-4(May-June 1968). (In Russian).

For investigation of the interaction of electrons and photons with energy up to 2 GeV, obtained from the linear accelerator LUE-2000, with nuclei and nucleons, an installation was developed which makes it possible to study the energy spectra and angular distributions of particles, originated or scattered in the investigated target. The installation consists of two rotating magnetic spectrometers, scattering chambers with device for the target and a monitoring system for the beam current, Faraday cylinder, and a system for the transfer of a beam to the target. The presence of two magnetic spectrometers makes possible both correlation measurements with simultaneous registration of two charged particles and independent measurements of particles, ejected from the target at two different angles. (tr-auth)

44568 APPARATUS FOR THE DETERMINATION OF THE INTENSITY OF A BEAM OF SECONDARY PARTICLES IN THE CHANNEL OF THE JINR SYNCHROPHASOTRON. Sikolenko, V. F. (Joint Inst. for Nuclear Studies, Dubna, USSR). Prib. Tekh. Eksp., No. 3, 25-9(May-June 1968). (In Russian).

An apparatus for the determination of the intensity of a beam of secondary particles in the channel of the JINR synchrophasotron was described. The determination was done by pulses of the deflecting magnetic field having a rise time of 15 to 20 μsec and a width of 2.5 msec. The fixed value of the intensity can be regulated from several units up to several decades of particles and is maintained with a precision of ±10%. (tr-auth)

44569 MEASUREMENT OF THE DENSITY OF THE SPACE CHARGE IN SYNCHROTRONS BY DISPLACEMENT OF THE BETATRON FREQUENCY TO RESONANCE VALUES. Stadnikov, A. G. (Inst. of Theoretical and Experimental Physics, Moscow). Prib. Tekh. Eksp., No. 3, 22-5(May-June 1968). (In Russian).

Integro-differential equations were derived which determine the invariants of the distribution of the space charge when the betatron frequency approaches the parametric resonance and then jumps it. An approximation method was developed for the solution of these equations by the adiabatic approach to resonance. During such motion, the distribution of the space charge describes the resonant, disturbing, varying width of the parametric resonance. (tr-auth)

44570 CHARGED-PARTICLE ACCELERATOR. Abrayman, Evgeny Abramovich; Gaponov, Vasily Alexndrovich (to Institut Yadernoi Fiziki). British Patent 1,121,467. July 31, 1968. Filed Aug. 20, 1965.

An accelerator which can accelerate charged particles to several MeV is described. It consists of an accelerating tube, a resonant transformer with a primary winding and a secondary winding coupled by a magnetic circuit, an impedance means so that the voltage waveform across the secondary winding and thus across the accelerating tube may be made to differ from that of the external supply, and a control means for controlling the circuit through the accelerating tube and thus controlling the energy spectrum of the charged-particle beam. (W.H.K.)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 43086, 43129, 43134, 44201, 44208, 44258, and 44775.

44571 (AAEC/TM–456) MEASUREMENTS IN PULSED BeO ASSEMBLIES WITH DECAY CONSTANTS IN THE REGION OF CORNGOLD'S LIMIT. Rainbow, M. T.; Ritchie, A. I. M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). May 1968. 30p. Dep.

Decay curves have been measured in BeO assemblies with bucklings in the range 1.93×10^{-2} cm^{-2} to 5.34×10^{-2} cm^{-2} at times from immediately after the initial pulse to at least 4.5 msec after the pulse. The decay curves for assemblies with $B^2 < 2.91 \times 10^{-2}$ cm^{-2} can be described by an exponential, from a minimum of 1.5 msec after the pulse to greater than 3.0 msec after the pulse. For bucklings greater than $B^2 = 3.3 \times 10^{-2}$ cm^{-2}, the decay curves can not be described by an exponential in this time region, and the departure from exponential increases with increasing buckling. The results indicate a transition region at $B^2 \sim 3.0 \times 10^{-2}$ cm^{-2}, ($\lambda \sim 3.65 \times 10^3$ sec^{-1}) which is consistent with the expression proposed by Kothari for the upper limit on discrete decay constants and well above Corngold's limit of $\lambda^* = (v\ \Sigma_{inel})_{min} \sim 2.5 \times 10^3$ sec^{-1}. The transition point does not have any marked shape dependence. There is some shape dependence in the behavior of decay curves for assemblies with $B^2 \geqq 3.3 \times 10^{-2}$ cm^{-2} but little dependence on pulse length, or counter shape and position. (auth)

44572 (ANL-Trans–638) TIME AND ENERGY DISTRIBUTION CHARACTERISTICS OF NEUTRONS EMITTED FROM HYDROGEN-CONTAINING RADIATORS. NEUTRON ABSORPTION TIME DISTRIBUTION IN A STRONGLY ABSORBING MEDIUM. Broder, D. L.; Kutuzov, A. A.; Khamyanov, L. P. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from report FEI–85. 9p. Dep. CFSTI.

The time and energy distributions of neutrons which depart from hydrogen-containing moderating radiators are considered. Results are discussed which have been obtained by the Monte Carlo method for a neutron source with a Maxwellian spectrum at various thicknesses of moderating radiators. Results from the calculation of the time distribution of the absorption of neutrons of different energies in plates consisting of a mixture of boron and hydrogen are discussed. (auth)

44573 (ANL-Trans–648) NEUTRON SPECTRUM ANISOTROPY IN WATER CLOSE TO AN ABSORBER. Ishmaev, S. N.; Sadikov, I. P.; Chernyshov, A. A. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from report IAE–1216. 19p. Dep. CFSTI.

Measurements were carried out of the spatial angular energy distribution of neutrons in water near a plane Cd surface in an experimental facility constructed on the linear accelerator. A method is described for the measurement of stationary neutron spectra by means of a chopper whose revolution is phased with the startup of the accelerator. Results from the measurements of the spatial dependence of spectra of neutrons which fly in two opposite directions: "from the absorber" and "to the absorber" show that there exists a strong anisotropy of the neutron spectrum near the absorbing surface. Values were obtained for the relaxation lengths of the effective temperature: lp ($\mu = +1$) = 7.6 mm and lp ($\mu = -1$) = 8.0 mm. Results are presented from measurements of the angular dependence of the neutron spectrum near the absorber. The analysis shows that an extremely essential factor which affects the shaping of the neutron spectrum close to the boundary of the absorber is the anisotropy of scattering of neutrons in water. (auth)

44574 (EIR-105) S_∞ TRANSPORT THEORY IN PLANE GEOMETRY. Mennig, J.; Marti, J. T. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Apr. 1968. 30p. Dep.

A semi-analytical method for solving the monoenergetic transport equation in plane geometry is developed in which the slab system is subdivided into a number of discrete space points in x, while the angular variable is treated analytically. General boundary conditions are introduced allowing finite multilayer slabs, cells, and shielding problems with specified incident angular distribution of neutrons to be handled by the same formalism. Analytical expressions are derived for the angular distributions and fluxes are obtained by solving a matrix problem, where the matrix elements are integrals over rational functions of the angular variable. Calculation times are comparable to low order S_N calculations. (auth)

44575 (IA–1169) AN ALTAC CODE PROGRAM FOR THE INTENSITIES OF NEUTRON DIFFRACTED FROM POLYCRYSTALLINE SAMPLES. Friedman, Z.; Shaked, H. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Dec. 1967. 23p. Dep.

An ALTAC III code for the intensities of neutrons diffracted from polycrystalline samples is given. The code is valid for the seven crystal systems and arbitrary direction of spin at any atomic position. (auth)

44576 (IPP–1/74) NEUTRON SOURCE FOR PRODUCTION OF INTENSIVE SHORT-LIVED NEUTRON PULSES. Schneider-Muntau, H. J. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Dec. 1967. 54p. (In German). Dep.

The method described by B. Kronast [Z.f. Angew. Physik, 15: 377 (1963)] of using a high-voltage, low-pressure discharge in deuterium to produce neutron pulses was further developed. Neutron yields of up to 5×10^{12} neutrons/sec of the $D(d,n)^3He$ reaction were attained for half-widths between 30 and 100 nsec. The known cross sections for collisions of electrons, fast deuterium ions, and fast neutral particles with D_2 molecules were used to obtain a conception of the ion production in the discharge and its correlation with the neutron yield. The heating of the target and the depth of penetration of the deuterons were estimated as well. An extremely low-inductance, high-current pulsed generator using cables for energy storage (open-circuit voltage 300 kV, internal impedance 54 ohm, inductance <500 nH, cable length 10 m) was constructed to provide the high voltage. A very fast high-voltage divider with a rise time <3.5 nsec was developed. A relation for determining the current from the voltage signal was derived. (auth)

44577 (NP–17572) SCATTERING OF POLARIZED D - D NEUTRONS IN A DIFFUSION CLOUD CHAMBER. Mulder, Jan Pieter Fokke (Groningen Rijksuniversiteit (Netherlands)). 1968. 151p. Dep.

Thesis.

A helium filled diffusion cloud chamber was used as a neutron polarimeter. The polarization of neutrons from the reaction $^2D(d,n)^3He$ at 350 keV and a 46.5° reaction angle was determined. The value of the polarization was larger than values found in previous experiments. This was attributed to the absence of background radiation influences. (J.W.R.)

44578 NEW SYNTHETIC SCATTERING KERNEL WITH APPLICATIONS IN NEUTRON TRANSPORT THEORY. Williams, M. M. R. (Queen Mary Coll., London). J. Phys., D, 1: 957–63 (Aug. 1968).

A new synthetic kernel, based on the secondary model of neutron scattering, is derived. The new model reproduces infinite-medium spectra in 1/v-poisoned media with considerable accuracy and behaves in many ways like a real, chemically bound moderator. The eigenfunctions of the scattering operator defined by the new kernel are found to be Laguerre polynomials but, unlike the heavy gas model which also has Laguerre polynomial eigenfunctions, the eigenvalues have a limit point behavior. This fact enables the space eigenvalues of the transport equation to assume a particularly useful form and overcomes the anomalous behavior observed when the heavy gas model is employed. The new kernel is more accurate than the heavy gas model, being valid for all values of moderator mass. It is also just as convenient from an analytical point of view, as illustrated by an example based on neutron diffusion in a temperature gradient. (auth) (UK)

44579 NEUTRON THERMALIZATION IN GRAPHITE. Navalkar, M. P.; Iyengar, S. B. D. (Bhabha Atomic Research Centre, Trombay, India). J. Nucl. Energy, 22: 391–6(July 1968).

The mean energy and average logarithmic energy decrement for an infinite medium of graphite at room temperature was studied by time-step and Monte Carlo methods for incident neutron energies of 0.11 and 0.01 eV, using the experimental values of Egelstaff for the scattering kernel. From the mean energies, the slowing down (τ_s) and heating up (τ_H) relaxation time constants were evaluated. Little difference was observed between τ_s (187 μsec) and τ_H (198 μsec). The calculated value of τ_s was in good agreement with the earlier experiments but differed from recent experiments. The average logarithmic decrement decreased with decreasing energy due to binding effects. (UK)

44580 SPATIAL-ENERGY DISTRIBUTION OF NEUTRONS IN THORIUM. Batyrbekov, G. A.; Nikolaev, M. N.; Uznadze, O. P. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 7: 17-25(1967). (In Russian).

The results of an investigation of the spatial-energy distribution of neutrons in the experimental fast reactor BR-1 with an active zone of ^{239}Pu and a ^{232}Th blanket were examined. A comparison was made of the experimental results and multigroup calculations for the reactor, carried out by different methods, with the purpose of experimental verification of the multigroup system of nuclear constants for thorium and plutonium and the accuracy of the calculation methods used. (tr-auth)

44581 EPITHERMAL ABSORPTION IN AN ISOLATED RESONANCE. Megier, J. (CCR-EURATOM, Ispra, Italy). J. Nucl. Energy, 22: 417-31(July 1968).

A method of calculating neutron resonance absorptions and flux spectra at epithermal energies in heterogeneous cells is described The integral transport equation was solved in the multigroup multiregion approach, following the first flight collision probability technique. As a first step the work was limited to the study of the 6.7-eV resonance of ^{238}U in a cylindrical cell. Comparisons with Monte Carlo calculations are reported, together with an analysis of the influence of the number of energy groups on the results. A study of the effect of the flat-flux approximation—in the fuel rod and in the moderator—on resonance absorption and the Doppler coefficient is then presented; typical values of 5 and 1%, respectively, were obtained, in good agreement with the results of other authors. (auth) (CANADA)

44582 PULSED NEUTRON MEASUREMENTS FOR BERYLLIUM IN THE RANGE OF LARGE BUCKLINGS. Graffstein, A.; Rzeszot, T.; Warda, E. (Inst. of Nuclear Research, Swierk, Poland). J. Nucl. Energy, 22: 433-43(July 1968).

Using the fast chopper as a pulsed neutron source the behavior of thermal neutron flux decay in Be was studied in the buckling range of 0.0838 to 0.285 cm^{-2}. The measurements were performed for cubic or near-cubic geometry. The neutron diffusion parameters were obtained. Some problems connected with pulsed measurements in Be are discussed. (auth)

44583 PULSED NEUTRON SOURCE COMPRISING A PLURALITY OF ALPHA SOURCES AND ASSOCIATED TARGETS WITH A ROTATABLE SHUTTER THEREBETWEEN. Caldwell, Richard L.; Givens, Wyatt W. (to Mobil Oil Corp.). U. S. Patent 3,389,257. June 18, 1968. Filed Sept. 15, 1964.

A mechanically actuated pulsed neutron source is described in which a rotating shutter moves between a number of alpha sources and their associated targets. The sources and targets are geometrically positioned to permit all of the targets to be irradiated simultaneously with alpha particles. The sources and targets are positioned in a helium-filled chamber. (D.C.W.)

44584 INELASTIC NEUTRON SCATTERING BY GASEOUS O_2. Summerfield, G. C.; Lurie, N. A. (Univ. of Michigan, Ann Arbor). J. Chem. Phys., 49: 890-2(July 15, 1968).

The magnetic contributions to neutron diffraction by molecular oxygen have been studied both experimentally and theoretically. The theoretical studies are extended by performing a calculation of the magnetic interaction in the inelastic neutron cross section for gaseous O_2. The magnetic inelastic cross section for O_2 is significantly different from the nuclear inelastic cross section due to the lack of spherical symmetry in the magnetic-moment distribution about each oxygen nucleus. It is expected from these results that the inelastic cross section for O_2 will provide more information about the magnetic-moment distribution than the angular distribution. Representative calculations are presented to indicate the size and nature of the magnetic contribution to the inelastic cross section. (auth)

44585 TWO-TIME DOUBLET BOLTZMANN EQUATION INCLUDING DELAYED NEUTRONS. Taji, Yukichi; Saito, Keiichi (Japan Atomic Energy Research Inst., Ibaraki). J. Nucl. Sci. Technol. (Tokyo), 5: 374-6(July 1968).

A previous derivation (J. Nucl. Sci. Technol. (Tokyo), 4: 518 (1967)) of the two-time doublet Boltzmann equation embodying a "one-collision operator" is extended to the case in which delayed neutrons are included. (J.W.R.)

44586 EXISTENCE OF DISCRETE EIGENVALUES IN SLAB LATTICE EXPONENTIAL EXPERIMENTS. Clancy, B. E.; Durance, G.; McCulloch, D. B. (Australian Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). (AAEC/TM-409).

A theoretical study was made of the neutron flux distributions in exponential experiments with regular alternating slabs of nonfissile materials. It was shown that discrete relaxation lengths need not exist in configurations where the source plane was perpendicular to the planes of the lattice slabs. The existence of non-existence depended on the relative thicknesses and the total cross sections of the lattice materials. For illustration, eigenvalue solutions of the monoenergetic transport equation were sought for two semi-infinite aluminium-water lattices of which only the first was found to support a discrete relaxation length. The flux distribution produced by a chosen source condition in the second lattice was studied by means of a two-dimensional transport calculation. The flux fine structure and spatial rate of decay were found to vary continuously in the lattice and to depend on the nature of the source. (auth)

44587 AN ^{124}Sb-Be SOURCE OF THERMAL NEUTRONS FOR PRECISION ANALYSIS AND TRACER PRODUCTION. Downs, W. E. (Atomic Energy of Canada Ltd., Ottawa). Nucl. Appl., 5: 55-61(Aug. 1968).

An improved ^{124}Sb-Be neutron source was developed to give a thermal flux of 6×10^8 n cm^{-2}sec^{-1} over a 20 cm^3 volume with a uniformity better than ±4%. With a unit of this type 90 radioisotopes with a specific activity of ≥ 0.1 μC/g can be produced. Because of the constancy of the flux, an analytical precision of ±1% is easily attainable. The present system will handle more than one sample transfer unit, allowing several simultaneous experiments or analyses. The pool system described here is a versatile research unit and not a general purpose industrial analytical facility. Considering the features and costs of this ^{124}Sb-Be source, it appears to be best suited for applications requiring a continuous thermal neutron flux, such as an on-line system for industry. (auth)

44588 EXPERIMENTAL STUDIES ON NUCLEAR REACTIONS AND ASSOCIATED PROBLEMS IN FAST NEUTRON DETECTION. Schwarz, Stephan. Stockholm, Stockholm Univ., 1967. 23p. Thesis.

A summary is made of 12 published papers on the following subjects: problems in treatment of data from nuclear counters; angular distributions of neutrons from the reaction ^{7}Li(α,n)^{10}B; some remarks on the properties of small organic scintillators as detectors for fast neutrons; elastic scattering of 14.8-MeV neutrons from ^{14}N and ^{16}O; determination of thickness of thin Li targets; relative measurement of the ^{6}Li(n,α)^{3}H reaction cross section in the range $1 < E_n < 600$ keV; absolute measurement of fast neutron flux with a large liquid scintillator; remarks on the ^{6}Li(n,α)^{3}H reaction cross section in the region $1 < E_n < 600$ keV; multiple scattering of fast neutrons in ^{6}Li glass scintillators; multiple scattering of fast neutrons in ^{10}B glass scintillators; inelastic scattering of 95-keV neutrons from the 45-keV level in ^{238}U; and angular distribution of neutrons from the ^{7}Li(p,n)^{7}Be reaction near threshold. (Sweden)

44589 DISCRETE ORDINATES NUMERICAL INTEGRATION METHOD FOR NEUTRON TRANSPORT EQUATION IN SLAB GEOMETRY. Takeuchi, Kiyoshi; Kataoka, Iwao (Ship Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 5: 342-9(July 1968).

A method is presented for solving neutron transport problems in slab geometry with the application of discrete ordinates numerical integration to the Boltzmann transport equation. Neutron spectra for water, iron and carbon layers are calculated and are compared with experimental data. Good agreement is obtained between computed and measured values for both angular distributions and the energy spectra of neutrons. The calculated neutron spectra in an iron-water layer are also presented as an example of solutions derivable for neutron transport problems in multilayered shield. (auth)

44590 TIME-DEPENDENT PROBABILITY OF THE NUMBER OF NEUTRONS AND THEIR COUNTS IN A MULTIPLYING MEDIUM. Inaba, Gohzoh (Tokyo Inst. of Tech.). J. Nucl. Sci. Technol. (Tokyo), 5: 378-80(July 1968).

An expression for the probability of the number of neutrons in a multiplying medium, and for the counts they occasion, is derived using both one-group fundamental-mode and two-forked approximations. (D.C.W.)

44591 NEUTRON POLARIZATION BY DOUBLE TRANSMISSION METHOD. Shadmanov, R. Sh. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR, No. 11, 17-19(1967). (In Russian).

The polarization and spectrum of the neutron beam in a reactor channel were investigated using a Be filter in the channel, together with two electromagnets that had steel blocks between their poles. Double transmission was obtained by wiring the electromagnets in parallel. (R.V.J.)

44592 PULSED NEUTRON MEASUREMENT IN BeO AND DERIVATION OF THE THERMAL NEUTRON DIFFUSION PARAMETERS FROM THE $\lambda(B^2)$ CURVE. Ritchie, A. I. M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). J. Nucl. Energy, 22: 371-85 (June 1968).

The decay constant of the neutron population was measured in BeO assemblies of various sizes. Particular attention was paid to the problem of "room return," establishment of the asymptotic mode, and the appearance of the continuous mode of decay. The best fit to the $\lambda(B^2)$ curve gave $\lambda_a = 1.954 \pm 0.076 \times 10^2$ sec^{-1}, $D_0 = 1.343 \pm 0.011 \times 10^5$ sec^{-1} cm^2, and $C = 4.88 \pm 0.31 \times 10^5$ sec^{-1} cm^4 for BeO of density 2.96 g cm^{-3} at a temperature of 22°C. These parameters can be used to derive $L = 26.22 \pm 0.51$ cm and $\lambda_{tr} = 1.619 \pm 0.013$ cm. The parametrization of the $\lambda(B^2)$ curve is discussed in conjunction with the problem of deciding when agreement exists between two separate measurements. (auth) (UK)

44593 THE MEAN NEUTRON DENSITY IN INHOMOGENEOUS MEDIA. II. Stepanov, A. V. (Moscow Inst. of Physics). Kernenergie, 11: 148-54(June 1968). (In Russian).

An approximation equation was obtained for the mean neutron flux from an elementary source in a diffusing medium with fluctuating parameters. Data on the structure of the medium were included in the correlation function of fluctuations and can be used for a wide range of diffusion media (from periodic structure of the 2.6 type to media with arbitrarily distributed impurities). An expression for a constant relaxation of a mean neutron flux is used as a typical parameter describing neutron migration in heterogeneous media. The results were used for determining the mean absorption cross sections and other pertinent magnitudes. (R.V.J.)

44594 ENERGY-LOSS NEUTRON EXPERIMENTS WITH A REACTOR. Whittemore, William L. (Gulf General Atomic Inc., San Diego, Calif.). Nucl. Appl., 5: 85-90(Aug. 1968).

A large segment of neutron scattering measurements is performed with the cold filter energy-gain scattering technique. A technique is proposed for deriving the same scattering information using time-of-flight energy-loss scattering technique but with significantly increased counting efficiency. This improvement is achieved using a standard neutron beam chopper and results from the use of the entire thermal spectrum from the reactor instead of 2% of the spectrum as in usual cold beam applications. A careful optimization of the proposed technique should increase the efficiency of data acquisition by at least a factor of 10. (auth)

44595 CRITICAL OPALESCENCE IN BINARY LIQUID MIXTURES. I. TEMPERATURE DEPENDENCE. Wignall, G. D.; Egelstaff, P. A. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., C, 1: 1088-96(Aug. 1968).

Critical opalescence in mixtures of Bi—Zn, Pb—Ga, and Bi—Ga was observed in the scattering of 5.3 Å neutrons. Separation of quasi-elastic from inelastic scattering was used to separate the long-range concentration fluctuation part of the cross section from other effects. To a first approximation, this cross section agreed with the Ornstein—Zernike theory of critical scattering. (auth)

44596 SECOND-ORDER EFFECTS IN DIFFUSE ELASTIC NEUTRON SCATTERING FROM FERROMAGNETIC ALLOYS. Balcar, E.; Marshall, W. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., C, 1: 966-72(Aug. 1968).

The corrections to the cross section for the diffuse elastic scattering of neutrons from ferromagnetic alloys, due to the inclusion of second-order effects in the fluctuations of short-range-order parameters, are derived for a suitable model. The limiting value of the cross section for forward scattering is obtained by considering the fluctuations of the total magnetization in a general way. The corrections are shown to be small and can be neglected in most cases. (auth)

44597 SCATTERING OF 14-MeV NEUTRONS. I. Azuma, Toshio; Sato, Yuji. Annu. Rep. Radiat. Center Osaka Prefect., 8: 43-9(1967).

A time-of-flight system for measuring neutron energies in scattering experiments is described. The alpha-particle and neutron detectors are plastic and liquid scintillators, respectively, with 6810A phototubes. The α-n coincidence pulse is used as the start pulse for the time-to-amplitude converter, and the 200-nsec delayed alpha pulse from a charge shaper circuit is the stop time. Time spectra of neutrons scattered from carbon are presented. (D.C.W.)

44598 SOLUTION OF THE TRANSPORT EQUATION FOR A MULTIPLYING SLAB BY LAPLACE TRANSFORMATION. Kobayashi, Keisuke; Nishihara, Hiroshi (Kyoto Univ.). Nukleonik, 11: 187-92(July 1968).

The one-dimensional transport equation for a uniform multiplying slab is solved. Applying the finite Laplace transformation, the regular Fredholm integral equation of the second kind where the unknown function is the angular flux at the slab boundary is derived. Solving this integral equation, the criticality factor and the angular flux at the boundary are obtained, and then using these boundary values the angular flux within the medium is obtained. As the first approximation, an integral equation for asymptotic angular flux is obtained. This asymptotic solution gives more accurate values for the critical slab thickness than the P-3 approximation. It is found that this asymptotic solution can also be obtained by the Pomraning and Clark's variational method using a trial function of the form of asymptotic angular flux. Since present formulations do not lead to singular integral equations as Mitsis's and Kiesewetter's do, the solution can be obtained easily. (auth)

44599 FIRST-FLIGHT ESCAPE PROBABILITY FOR BODIES CONTAINING A CENTRAL BLACK REGION. Smith, Owen J.; Murray, Raymond L. (North Carolina State Univ., Raleigh). Nucl. Sci. Eng., 33: 341-3(Sept. 1968).

First-flight transport kernels are developed for a finite spherical region containing a black central zone. The uncollided angular flux distribution is obtained for a source uniformly distributed throughout the annulus, enabling the formulation of the current for any point in the medium and the calculation of the first-flight escape probabilities for various annular sizes. (J.W.R.)

44600 SOLUTION OF THE ONE-VELOCITY EQUATION OF NEUTRON TRANSPORT IN A SPHERICALLY SYMMETRICAL MEDIUM. Shkurpelov, A. A.; Ershov, Yu. I. Zh. Vychisl. Mat. i Mat. Fiz., 7: 1402-6(1967). (In Russian).

The nonhomogeneous one-velocity (monoenergetic) kinetic equation in a spherical geometry with isotropic scattering index and homogeneous boundary are transformed to a similar equation in plane geometry, which can be solved successfully by a method developed by Case. The equation is expressed in integral form and is simplified by the introduction of new functions in the same variables. After the introduction of new variables, the final equations are conveniently solved by the method of iteration. The asymptotic (zero approximation) solution is given of the equation under consideration. (ATD)

Nuclear Properties and Reactions, A≤ 5

Refer also to abstracts 42698, 44576, 44644, 44646 and 44779.

44601 $D(^3He,\gamma)^5Li$ REACTION FROM 2 to 11 MeV. Del Bianco, W.; Lemire, F.; Levesque, R. J. A.; Poutissou, J. M. (Univ., Montreal). Can. J. Phys., 46: 1585-7(July 15, 1968).

The 90° yield of the $D(^3He,\gamma)^5Li$ reaction was measured from 2.3 to 11.2 MeV ^3He energy. No clear evidence of a level in ^5Li was found over this energy range. The upper limits for the resonance integrated cross section and gamma-ray width were estimated to be $\sigma_{int} \sim 15$ μb MeV and $\Gamma_\gamma \sim 100$ eV, respectively. (auth) (CANADA)

44602 MODEL DEPENDENCE OF G_{en} AND THE DEUTERON WAVE FUNCTION. Signell, P.; Parker, P. M. (Michigan State Univ., East Lansing). Phys. Lett., 27B: 264-6(Aug. 5, 1968).

The threshold values of the neutron electric form factor have been previously found to depend on the nucleon-nucleon model used in extracting those values from the e-D scattering data. That model dependence is shown to be correlated with a range of deuteron quadrupole moment (Q_D) model values which is much larger than the present uncertainty in Q_D. (auth)

44603 TRITON VARIATIONAL CALCULATIONS WITH TRIAL FUNCTIONS WHICH ARE NOT OF THE PRODUCT TYPE. Homan, D. H. (State Univ., Groningen, Netherlands); Kok, L. P.; Van Wageningen, R. Nucl. Phys., A117: 231-7(1968).

Some new calculations for the simple triton model considered previously (Nucl. Phys., A98: 365(1967)) are reported. Variational calculations for the ground-state energy have been performed with trial functions which are of the "double product type" $f(r_1)f(r_2)f(r_3) + g(r_1)g(r_2)g(r_3)$. The conclusions are that the calculated energy value is probably relatively much closer to the exact energy than the value calculated with the best possible trial function of the product type and that the local energy $H\psi/\psi$ improves considerably, especially for small interparticle distances. (auth)

44604 THREE-BODY CALCULATION OF DEUTERON—ALPHA SCATTERING AND POLARIZATION. Shanley, Paul E. (Univ. of Califonria, Davis). Phys. Rev. Lett., 21: 627-30 (Aug. 26, 1968).

Three-body calculations using separable two-body interactions were carried out for the deuteron-alpha system with the alpha particle assumed to be structureless. Phase shifts, angular distributions, and polarization were calculated and were found to be in substantial agreement with experiment. (auth)

44605 SUM RULES FOR ^{4}He. Quarati, Piero (Univ., Cagliari, Italy. Glasgow Univ.). Nucl. Phys., A115: 651-60 (1968).

Deduction of electric multipole sum rules for electromagnetic interaction with nuclei and their relations with correlation functions are discussed. Multipole sum rules are applied to the shell-model wave functions. In particular, the photodisintegration of ^{4}He is studied. In this case, the contribution of electric quadrupole part is very important for the exact determination of the mean square radius. (auth)

Nuclear Properties and Reactions, $6 \leq A \leq 19$

Refer also to abstracts 42698, 44644–44646, 44649, 44773, 44779, and 44782.

44606 ELASTIC AND INELASTIC SCATTERING OF 155-MeV PROTONS BY ^{6}Li, ^{7}Li, ^{11}B, AND ^{14}N. Geoffrion, B.; Marty, N.; Morlet, M.; Tatischeff, B.; Willis, A. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys., A116: 209-33(1968). (In French).

The 1 p-shell nuclei ^{6}Li, ^{7}Li, ^{11}B, and ^{14}N were studied by elastic and inelastic scattering of 155-MeV protons. Cross sections and polarizations were measured. An optical-model analysis is performed on the elastic scattering results. The inelastic scattering results are compared with theoretical calculations obtained on the basis of the plane-wave impulse approximation with shell and rotational models. (auth)

44607 POLARIZATION OF NEUTRONS FROM THE ^{15}N(d,n)^{16}O REACTION FOR DEUTERON ENERGIES FROM 3.1 TO 3.8 MeV. Meier, M. M.; Thomason, R. S.; Walter, R. L. (Duke Univ., Durham, N. C.). Nucl. Phys., A115: 540-4(1968).

The polarization of neutrons from the ^{15}N(d,n)^{16}O reaction was measured at five deuteron energies between 3.1 and 3.8 MeV over the angular region from 10 to 137° (c.m.). Although the differential cross section exhibits appreciable forward peaking in this energy range, large variations in the polarization were observed, even in the region of the stripping peak. (auth)

44608 FAST PHOTONEUTRON SPECTRA DUE TO 55- TO 85-MeV PHOTONS. Kaushal, Narinder N. Troy, N. Y., Rensselaer Polytechnic Inst., 1967. 211p.

Thesis.

Energy spectra of fast photoneutrons from eighteen elements (Li, Be, B, C, N, O, Al, S, Fe, Cu, In, Sn, Ta, Tl, Pb, Bi, and U) were measured at 67.5°, using thin target bremsstrahlung from the Rensselaer linac. The neutron detection system utilized a 100-meter flight path with overall time resolution of 0.4 nanoseconds per meter. Measurements of the spectra from each target at bremsstrahlung energies of both 55 and 85 MeV permitted extraction of a neutron spectrum in each case which is effectively due to photons between 55 and 85 MeV. Cobalt foils were used as relative photon monitors. Absolute normalization of the spectra was effected by comparison with the experimentally measured photoneutron spectrum of deuterium. The systematic dependence of the neutron production cross sections on target Z was compared to the predictions of the modified quasi-deuteron model taking account of optical attenuation. The effect of secondary neutron production was estimated by approximate Monte Carlo calculations. It is found that the results are in agreement with the quasi-deuteron model. (Diss. Abstr.)

44609 ANALYSIS OF TWO RESONANCES IN ^{7}Be. Lejeune, A. (Univ. of Liege). Nucl. Phys., A116: 72-82(1968).

The cross sections of three reactions ^{6}Li(p,p)^{6}Li, ^{4}He(^{3}He,^{3}He)^{4}He, and ^{6}Li(p,^{4}He)^{3}He are simultaneously analyzed in the framework of S-matrix theory. The values of the resonance parameters of some levels of the compound nucleus ^{7}Be are determined and compared with those derived from previous analysis. The ratio $q_n = (\Sigma_c + \Gamma^0_{ca})/\Gamma_n$ which occurs in the S-matrix parametrization is evaluated for two levels of ^{7}Be and found close to unity. (auth)

44610 STRUCTURE OF THE ^{14}N NUCLEUS USING DEFORMED ORBITALS. Radhakant, S.; Ullah, Nazakat (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys., A116: 43-8 (1968).

Axially deformed single-nucleon Hartree-Fock orbitals are obtained for the ^{14}N nucleus without assuming any degeneracy between the single-nucleon and its time-reversed state. Low-lying even-parity states are calculated by taking into account the band mixing. The ground-state magnetic dipole moment and the electric quadrupole moment are in excellent agreement with their experimental values. The M1 transition strengths are also calculated and are compared with the earlier intermediate-coupling calculations. The single-particle Hartree-Fock Hamiltonian is used to construct the lowest unoccupied even-parity orbital. This deformed orbital is used to calculate the low-lying odd-parity states of the ^{14}N nucleus. (auth)

44611 ELECTROMAGNETIC TRANSITIONS IN ^{11}B AND ^{14}C. Bell, R. A. I.; Gill, R. D.; Robertson, B. C.; Lopes, J. S.; Rose, H. J. Oxford, Oxford University, 1968. 45p.

The ^{12}C(t,a) and ^{12}C(t,p) reactions were used in conjunction with standard particle-gamma ray correlation techniques to study excited states of ^{11}B and ^{14}C. The following spins, branching ratios, and electromagnetic multipole mixing ratios were determined: for the ^{11}B 5.02 MeV level: $J = 3/2$, transition (5.02 → g.s.) : (88 ± 2.5)%, $\delta(E2/M1) = 0.03 \pm 0.05$, and transition (5.02 → 2.12) : (12 ± 2.5)%, $\delta(E2/M1) = -0.05 \pm 0.2$; for the ^{11}B 4.44 MeV level, transition (4.44 → g.s.) : $\delta(E2/M1) = -0.19 \pm 0.03$; for the ^{14}C 6.72 MeV level: J = 3, transition (6.72 → 6.09) : 2.7 ± 1)%; for the ^{14}C 7.01 MeV level : J = 2, transition (7.01 → 6.09) : (1.4 ± 0.7)%; for the ^{14}C 7.35 MeV level : J = 2, transition (7.35 → g.s.) : (14 ± 4)%, transition (7.35 → 6.09) : (52 ± 5)%, $\delta(M2/E1) = -0.04 \pm 0.09$, and transition (7.35 → 6.72) : (34 ± 4)%, $\delta(M2/E1) = 0.07 \pm 0.3$. The results are compared with model predictions. (auth) (UK)

44612 EVIDENCE FOR A NUCLEAR TENSOR FORCE FROM MASS-14 BETA- AND GAMMA-RAY DATA. Rose, H. J. (Oxford Univ.); Haeusser, O.; Warburton, E. K. Rev. Mod. Phys., 40: 591-610(July 1968).

The role of beta- and gamma-ray matrix elements in the determination of wave functions for the s^4p^{10} states of mass 14 is examined. The data considered include the Gamow–Teller (beta) matrix elements of ^{14}C and ^{14}O and the M1 and E2 matrix elements connecting the lowest four s^4p^{10} states of ^{14}N. The magnetic moment of ^{14}N is also discussed. The shell-model wave functions considered arise mainly from the s^4p^{10} configuration but include admixtures of the s^4p^8 (2s, 1d) configuration. It is found that the data, considered as a whole, cannot be explained if the s^4p^{10} components of the wave functions are derived from a central plus spin–orbit interaction only, but that quite satisfactory agreement is obtained if the nuclear force includes a tensor part. The bulk of the cancellation of the ^{14}C beta decay matrix element takes place within the s^4p^{10} configuration. In general, configuration mixing is of secondary importance; its most noticeable effect is on the M1 decay of the first-excited state of ^{14}N. (auth)

44613 SPECTROSCOPY OF ^{14}N BY USE OF THE ^{12}C(^{3}He,p)^{14}N REACTION. Mangelson, Nolan F.; Harvey, Bernard, G.; Gledenning, Norman K. (Univ. of California, Berkeley). Contract W-7405-eng-48. Nucl. Phys., A117: 161-84(1968). (UCRL–17977).

Spectra and angular distributions were obtained for the reaction ^{12}C(^{3}He,p)^{14}N at E(^{3}He) = 20.1 MeV from $\theta_{lab} = 8$ to 170°. Distorted-wave calculations were compared to experimental angular distributions and relative total cross sections. Agreement was found when a spin-independent interaction potential was used. Nuclear wave functions used in the calculations are discussed. Spectroscopic and configuration assignments were made or confirmed on the basis of excitation energy, angular distribution, comparison of (α,d) and (^{3}He,p) results, relative total cross sections and comparison of experimental results with distorted-wave Born approximation calculations. A spin and parity assignment of 2^- and a tentative assignment of 4^+ were made for the 9.388- and 10.85-MeV, T = 0 levels, respectively. Configurations are suggested for the 8.979-, 10.213-, and 10.85-MeV levels. (auth)

44614 14.4-MeV NEUTRON-INDUCED REACTIONS ON ^{19}F. Rendic, D.; Antolkovic, B.; Paic, G.; Turk, M.; Tomas, P. (Inst. Ruder Boskovic, Zagreb). Nucl. Phys., A117: 113-23(1968).

Spectra and angular distributions were measured at $E_n = 14.4$ MeV for (n,p), (n,d), (n,t), and (n,α) processes on ^{19}F leading to the ground state and to some low-lying levels of the residual nuclei. The (n,d) differential cross sections were analyzed using the DWBA calculation. The spectroscopic factors were extracted and were compared with those calculated on the basis of the shell model. The (n,t) data were analyzed in terms of the Butler theory, while the (n,α) angular distribution was compared with the Hauser–Feshbach theory. (auth)

44615 THE (d,t) REACTION ON ^{13}C. Tesch, S.; Baldeweg, F.; Bredel, V.; Guratzsch, H.; Klabes, R.; Stiller, G. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Nucl. Phys., A117: 66-72(1968).

Angular distributions of tritons leading to the 0^+ ground state and 2^+ first excited state of ^{12}C were measured at bombarding energies of 12.1, 13.3, and 14.0 MeV. A clear J-dependence of these angular distributions was observed, resulting from the pick-up of a $p_{1/2}$ or $p_{3/2}$ neutron, respectively. DWBA calculations were carried out, and the extracted spectroscopic factors are compared with those from other reactions and intermediate coupling predictions. (auth)

44616 OBSERVATION OF A 9.15-MeV DOUBLET LEVEL IN ^{15}N FROM A STUDY OF THE $^{14}N(n,\gamma)^{15}N$ REACTION. Greenwood, R. C. (Idaho Nuclear Corp., Idaho Falls). Phys. Lett., 27B: 274-6(Aug. 5, 1968).

Precise measurement of prompt γ-ray energies from the $^{14}N(n,\gamma)^{15}N$ reaction has provided information about the energies and decay modes of the 9.15-MeV doublet levels in ^{15}N. A value of $10,833.2 \pm 0.6$ keV was obtained for the Q-value. (auth)

44617 ELECTROMAGNETIC TRANSITION STRENGTHS IN ^{14}C AND ^{14}N. Allen, K. W.; Alexander, T. K.; Healey, D. C. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 46: 1575-84(July 15, 1968). (AECL–3120).

The lifetimes of the 5.10-MeV and 5.83-MeV levels in ^{14}N and the 6.72-MeV level in ^{14}C were measured using a recoil distance method and the $T(^{12}C,n\gamma)^{14}N$ and $T(^{12}C,p\gamma)^{14}C$ reactions respectively. The lifetimes were 12.4 ± 1.4 and 18 ± 2 ps for the 5.10-Mev and 5.83-MeV levels in ^{14}N respectively and 97 ± 15 ps for the 6.72-MeV level in ^{14}C. These measurements were combined with previous determinations of gamma-ray branching and multipole mixing ratios to obtain the strengths of the transitions involved. Comparison of the strengths with recent calculations showed agreement in general. The ground-state E3 transitions from the 5.10-MeV levels in ^{14}N and the 6.72-MeV level in ^{14}C are enhanced by 2.2 ± 0.7 and 3.3 ± 0.8 Weisskopf units respectively. The isotopic spin selection rule for E1 and M2 transitions in the self-conjugate nucleus ^{14}N was observed and discussed for some transitions. For example, the allowed M2 transition from the 5.10-MeV to the 2.31-MeV level had $|M|^2 = 0.83 \pm 0.14$ Wu, whereas the isotopic spin-forbidden M2 part of the 5.10-MeV to ground-state transition had $|M|^2 = 3.3 \pm 1.3 \times 10^{-3}$ Wu. (auth) (CANADA)

44618 CHARGE-EXCHANGE PION SCATTERING BY ^{13}C. Bakke, Finn H.; Reitan, Arne (Norges Tekniske Hoegskole, Trondheim, Norway). Ark. Fys. Seminar Trondheim, No. 5, 11p. (1968).

The cross section for the reaction $^{13}C(\pi^+,\pi^0)^{13}N$ is calculated for the region around the first resonance in the pion-nucleon system. The calculations are based upon the dispersion methods developed by Shapiro and collaborators. (auth) (Norway)

44619 NEUTRON–NUCLEI TOTAL CROSS SECTIONS AT 27 GeV/c. Jones, L. W. (Univ. of Michigan, Ann Arbor); Longo, M. J.; O'Fallon, J. R.; Kreisler, M. N. Contracts NONR 1224(23); AT(30-1)-2137. Phys. Lett., 27B: 328-31(Aug. 5, 1968).

The total cross sections for 27-GeV/c neutrons on eight heavy elements, Be through U, were measured and were found to obey the empirical relation $\sigma_T = 48\ A^{0.75}$ mb. (auth)

44620 GROUND STATE OF THREE α PARTICLES. Fulco, J. R. (Univ. of California, Santa Barbara); Wong, D. Y. Phys. Rev., 172: 1062-4(Aug. 20, 1968).

The Faddeev equation is applied to solve for the energy of three α particles using a local static two-body potential obtained by fitting scattering phase shifts. A single bound state is found with a binding energy of 2.79 MeV. Although this value is not very close to the ground-state energy of ^{12}C, the existence of a 3-α bound state with a binding energy of several MeV indicates that the main structure of ^{12}C is like a composite of three α particles. The effect of inelastic processes is estimated in a rough approximation by using a two-channel two-body potential. It is shown that they can easily increase the binding energy of the 3-α bound state by several MeV. (auth)

44621 CAPTURE AND ELASTIC SCATTERING OF PROTONS BY ^{14}C. Henderson, Jerry D.; Hudspeth, Emmett L.; Smith, William R. (Univ. of Texas, Austin). Phys. Rev., 172: 1058-62 (Aug. 20, 1968).

The reactions $^{14}C(p,\gamma)^{15}N$ and $^{14}C(p,p)^{14}C$ were studied in the energy region $0.6 < E_p < 2.7$ MeV. Particular attention was directed to a level which is produced at $E_p = 2.49$ MeV ($E_x = 12.54$ MeV); this level is distinct from a frequently observed level at $E_x = 12.51$ MeV. It is concluded on the basis of a dispersion-theory fit to the scattering data that the 12.54-MeV level has $T = {}^3/_2$, $J = {}^5/_2{}^+$, and that it is the analog of the first excited state in ^{15}C. (auth)

44622 THE $^{13}C[^3He,^8Be(g.s.)]^8Be(g.s)$ REACTION. Jayaraman, K. S.; Holmgren, H. D. (Univ. of Maryland, College Park). Phys. Rev., 172: 1015-21(Aug. 20, 1968).

The differential cross sections for the $^{13}C[^3He, ^8Be(g.s.)]^8Be$ (g.s.) reaction was measured as a function of angle at bombarding energies of 3.30, 5.00, and 5.75 MeV, and as a function of the bombarding energy over the range extending from 2.50 to 5.00 MeV at a laboratory angle of 40°. The reaction exhibits a pronounced resonance at about 5.6 MeV corresponding to an excited state of ^{16}O at an excitation energy of 16.75 MeV. The angular distribution on the resonance suggests an assignment of $J^\pi = 2^+$. The total off-resonance cross section for the reaction is surprisingly large: 0.18 mb at 3.30 MeV and 0.37 mb at 5.00 MeV. The behavior of the off-resonance differential cross section suggests the possibility of direct reaction. The angular distributions at 3.30 and 5.00 MeV have been fitted with a distorted-wave Born-approximation calculation in which a five-nucleon system was assumed to be transferred from ^{13}C to ^3He as a point particle. The gross approximations which had to be employed in the calculation do not allow a meaningful spectroscopic factor to be extracted. The reaction, however, plays a significant part in the interaction of ^3He with ^{13}C. (auth)

44623 SEQUENTIAL REACTIONS FROM ^6Li ON ^9Be. Jambunathan, Ramanathan; Hobbie, Russell K. (Univ. of Minnesota, Minneapolis). Phys. Rev., 172: 1065-71(Aug. 20, 1968).

Various sequential reactions resulting from $^9Be\ (^6Li,\alpha)$ were studied to look for levels in ^{11}B having a $(^9Be + d)$ structure. The studies included measurement of particle-γ and particle-particle coincidences. No unusual levels were found. (auth)

44624 PERTURBED ANGULAR DISTRIBUTION OF RECOIL IMPLANTED ^{19}F NUCLEI IN A NICKEL ENVIRONMENT. Klepper, O.; Spehl, H. (Univ., Freiburg i. B.). Z. Phys., 215: 17-27(1968).

Magnetic hyperfine fields acting on ^{19}F in a nickel lattice were investigated. Time-dependent spin rotation was observed following the excitation and recoil implantation with a pulsed proton beam using the reaction $^{19}F(p,p')^{19*}F$. Two hyperfine fields were detected at 290°K: $H_{hf}^{(1)} = +\ 17.6 \pm 0.5$ kG and $H_{hf}^{(2)} = +\ 91 \pm 3$ kG. The variation of the effective fields with the external polarizing field was studied. The mean life of the 197-keV level was remeasured to be 128 ± 2 nsec. (auth)

44625 REANALYSIS OF THE $^7Be(p,\gamma)^8B$ CROSS-SECTION DATA. Parker, P. D. (Yale Univ., New Haven). Astrophys. J., 153: L85-6(Aug. 1968).

Because of the present interest in the $^7Be(p,\gamma)^8B$ reaction in relation to the solar-neutrino experiment, it seemed important to note the results of a reanalysis of the author's earlier cross-section data for this reaction (Parker 1966a, b). This reanalysis concerns correcting the cross-section data explicitly for the effects of the 735-keV resonance and renormalizing the data to a more reasonable value for the $^7Li(d,p)^8Li$ cross section. (W.D.M.)

44626 STUDY OF (n,α) REACTIONS AND THE NUCLEI ^{16}O AND ^{14}N AT 14.9 MeV. Leroux, B. (Laboratoire de Physique Nucleaire, Bordeaux); El-Hammami, K.; Dalmas, J.; Chastel, R.; Lamot, G.; Fayard, C.; Boutros, J. Hajj. Nucl. Phys., A116: 196-208(1968). (In French).

The $^{16}O(n,\alpha)^{13}C$ and $^{14}N(n,\alpha)^{11}B$ reactions induced by 14.9-MeV neutrons were studied with the nuclear emulsion method. The angular distributions were obtained from 20 to 160° for the transitions $^{16}O(n,\alpha_0)^{13}C$, $^{14}N(n,\alpha_0)^{11}B$ and $^{14}N(n,\alpha_1)^{11}B$; they are compared to the predictions of direct interaction mechanisms. (auth)

Nuclear Properties and Reactions, $20 \leq A \leq 89$

Refer also to abstracts 42698, 42829, 44452, 44608, 44619, 44712, 44724, 44732, 44733, 44744, 44772 –44774, 44782, 44797, and 44800.

44627 (TID–24601) NEUTRON RADIATIVE CAPTURE IN Na, Al, Fe, AND Ni FROM 1 TO 200 keV. Hockenbury, R. W.; Bartolome, Z. M.; Tatarczuk, J. R.; Moyer, W. R.; Block, R. C. (Rensselaer Polytechnic Inst., Troy, N. Y.). [1968]. 82p. Dep. CFSTI.

Neutron radiative capture in Na, Al, Fe, and Ni was measured from 100 eV to 200 keV with a 1.25-meter diameter liquid scintillator detector at the Rensselaer LINAC Laboratory. Radiative widths were determined from those resonances where the neutron widths are well known, while the resonance capture areas $(\sigma_0\Gamma_\gamma)$ were determined for most of the other resonances. Considerably more resonances were observed in the capture measurements upon Fe and Ni than had been observed in total cross section measurements. It is reasonable to assign most if not all these previously undetected resonances to p-wave neutrons; and from these data p-wave strength functions of $0.10 \pm 0.04 \times 10^{-4}$ and $0.04 \pm 0.03 \times 10^{-4}$ were determined, respectively, for ^{56}Fe and ^{58}Ni. These strength functions are probably an upper limit to the true p-wave strength functions and are an order of magnitude smaller than optical model predictions. (auth)

44628 (UJV–2024) A STUDY OF THE RADIAL DEPENDENCE OF THE RESIDUAL INTERACTION: THE OCTUPOLE COLLECTIVE STATES IN THE Sn AND Zr ISOTOPES. Rizek, J.; Vogel, P. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). May 1968. 12p. Dep.

The energies and transition probabilities of the low-lying $I^\pi = 3^-$ states in the Sn and Zr isotopes are calculated by the Random Phase Approximation (RPA) method. Three different types of residual interaction are used: the octupole–octupole force, the surface δ-interaction and the usual δ-interaction. The results are practically independent of the type of the residual interaction used. The conclusion is made that the main characteristics of the collective state are independent of the radial form of the residual interaction. (auth)

44629 REACTIONS $^{12}C(\alpha,n)^{15}O$ AND $^{12}C(\alpha,p)^{15}N$. Black, J. L.; Kuan, H. M.; Gruhle, W.; Suffert, M.; Latshaw, G. L. (Stanford Univ., Calif.). Nucl. Phys., A115: 683-96(1968).

The total neutron cross section for the reaction $^{12}C(\alpha,n)^{15}O$ was measured by an activation method from threshold at $E_\alpha = 11.345$ MeV to 22.65 MeV. The differential cross sections at $\theta_{lab} = 115.5$, 147.0, 160.5, and 167.0° for $^{12}C(\alpha,p_0)^{15}N$ from $E_\alpha = 13.05$ to 23 MeV and for $^{12}C(\alpha,p_{1+2})^{15}N$ from $E_\alpha = 19$ to 23 MeV were also measured. The correlations between the observed structure and that observed in other reactions proceeding through the giant dipole region of ^{16}O are discussed. A fluctuation analysis is applied above $E_\alpha = 15$ MeV and gives $\Gamma_{c.m.} = 100$ keV. (auth)

44630 FORBIDDEN M1 TRANSITIONS. Zamick, Larry (Rutgers-The State Univ., New Brunswick, N. J.); Ripka, Georges. Nucl. Phys., A116: 234-40(1968).

The M1 transitions of ^{43}Ca, which would vanish if one used $f_{7/2}^3$ configurations only, are calculated including all the 2p–1f shell configurations. The M1 transitions of ^{41}Ar are also discussed. The effects of low-lying core excited states, i.e., five-particle–two-hole states, are estimated and are found to be insignificant because of special properties of the M1 operator. (auth)

44631 γ-RAY SPECTRA OF ANALOGUE RESONANCES IN THE $^{48}Ti(p,\gamma)^{49}V$ REACTION. Fodor, Ilona; Demeter, I.; Keszthelyi, L.; Szentpetery, I.; Szoekefalvi-Nagy, Z.; Szuecs, Judith; Varga, L.; Zimanyi, J. (Central Research Inst. for Physics, Budapest). Nucl. Phys., A116: 167-76(1968).

The γ-ray spectra from the 1.007-1.013 MeV double and 1.362 MeV single resonances of $^{48}Ti(p,\gamma)^{49}V$ were measured with scintillation and Ge(Li) detectors. Branching ratios and transition widths were determined and were compared with theoretical values. (auth)

44632 NEUTRON PICK-UP ON THE FIVE STABLE ISOTOPES OF TITANIUM VIA THE (^3He,^4He) REACTION. Lutz, H. F.; Bohn, T. S. (Univ. of California, Livermore). Contract W-7405-eng-48. Nucl. Phys., A116: 112-28(1968). (UCRL–70316).

A magnetically analyzed beam of ^3He particles accelerated by the Livermore variable energy cyclotron was used to study neutron pick-up reactions on the five stable isotopes of titanium. The reaction leads to states with isospins $T + \frac{1}{2}$ and $T - \frac{1}{2}$ (where $2T = N - Z$ is the isospin of the nucleus). The results of the experiment were compared with the neutron pick-up studies carried out with the (p,d) reaction. The distribution of the $l_n = 3$ strengths was compared with the predictions of the $(1f_{7/2})^n$ configuration calculation of McCullen, Bayman, and Zamick. (auth)

44633 HIGH-ENERGY ELECTRON SCATTERING BY NUCLEI ^{24}Mg AND ^{28}Si AND α-PARTICLE MODEL. Savitskii, G. A.; Afanasev, N. G.; Gulkarov, I. S.; Khvastunov, V. M.; Khomich, A. A.; Shevchenko, N. G. Yadern. Fiz., 7: 1181-4(June 1968). (In Russian).

High-energy (100 to 260 MeV) electron scattering by the nuclei ^{24}Mg was measured. Form factors for elastic and inelastic scatterings with the excitation of the 1.37-MeV level, the 4.1-MeV doublet level, and the 6.0-MeV level are obtained. These data, as well as the data on the elastic and inelastic scatterings previously obtained with the excitation of 1.78- and 4.62-MeV levels in the nuclei ^{28}Si, are compared with predictions of the α-particle model. It is established that the 6.0-MeV (4^+) level of ^{24}Mg refers to the rotational band based on the ground state. (auth)

44634 STRUCTURE OF CROSS SECTIONS OF THE (γ,n) REACTIONS ON THE NUCLEI ^{28}Si, ^{32}S, AND ^{40}Ca. Goryachev, B. I.; Ishkhanov, B. S.; Shevchenko, V. G.; Yurev, B. A. (Inst. of Nuclear Physics, Moscow). Yadern. Fiz., 7: 1168-80(June 1968). (In Russian).

By means of direct registration, the photoneutron yields from the threshold of the reaction (γ,n) up to 30 MeV on the nuclei ^{28}Si, ^{32}S, and ^{40}Ca were measured. The cross sections of the reaction (γ,n) are compared with the calculations performed within the framework of the particle-hole approach. It is shown that for the nuclei ^{28}Si and ^{32}S the configuration splitting of the giant resonance is the main effect that determines the "gross" structure of cross sections of the (γ,n) reaction. (auth)

44635 RESONANCE FLUORESCENCE AND ABSORPTION MEASUREMENTS OF TRANSITION STRENGTHS IN ODD-MASS NUCLEI. Alston III, W. J.; Wilson, H. H.; Booth, E. C. (Boston Univ.). Nucl. Phys., A116: 281-8(1968).

Partial widths of nuclear levels between 0.8 and 3.0 MeV in ^{55}Mn, ^{59}Co, ^{63}Cu, ^{69}Ga, ^{75}As, and ^{89}Y are reported using resonant scattering and self-absorption measurements of electron bremsstrahlung. Multipole mixing is deduced in cases where $\Gamma(E2)$ has been previously measured. (auth)

44636 A STUDY OF THE $^{28}Si(d,^3He)^{27}Al$ REACTION. Gove, H. E.; Purser, K. H.; Schwartz, J. J.; Alford, W. P.; Cline, D. (Univ. of Rochester, N. Y.). Nucl. Phys., A116: 369-86(1968).

Spectroscopic factors were measured for all the levels in ^{27}Al up to 3 MeV from the reaction $^{28}Si(d, ^3He)^{27}Al$. The level at 3.00 MeV with $J^\pi = 9/2^+$ is excited much more strongly than that at 2.98 MeV with $J^\pi = 3/2^+$, although it does not show either an $l = 2$ or an $l = 4$ pick-up distribution. The results are not in agreement with the collective rotational model. Better, but still not very good, agreement is found with the weak-coupling core-excitation model. Occupation numbers are obtained for protons in $d_{5/2}$, $d_{3/2}$ and $s_{1/2}$ orbits for the ground state wave function of ^{28}Si. These are compared with the neutron occupation numbers. (auth)

44637 THE 2.07-MeV LEVELS OF ^{26}Al. Da Silva, C. M.; Lisle, J. C. (The Univ., Manchester, Eng.). Nucl. Phys., A116: 452-64(1968).

The existence of three very closely separated levels at 2.07 MeV in ^{26}Al was established. The principal decay modes of these and two higher states are discussed. Angular correlation measurements lead to spin assignments of 1 and 2 for two of the states at 2.07 MeV, and the $J = 2$ level is identified as the second $T = 1$ state in ^{26}Al. Evidence is presented for assigning $J^\pi = 1^+$ to the 1.85 MeV state. (auth)

44638 THE DECAY OF ^{70}As. de Ruiter, A. P. (Vrije Univ., Amsterdam); Verheul, H.; Konijn, J. Nucl. Phys., A116: 473-80 (1968).

The decay of ^{70}As to ^{70}Ge was investigated with Ge(Li) detectors. From the single gamma-ray spectrum measured with a 15 cm^3 and a 30 cm^3 Ge(Li) detector, the energies and relative intensities of 66 gamma rays with energies up to 4.4345 MeV were deduced. Several unknown gamma rays were found. With two Ge(Li) detectors (8 cm^3 and 20 cm^3), coincidences between the stronger gamma rays were measured. From these data, the decay scheme was constructed, and the intensities of the β^+ and electron capture feeding of the levels were deduced. Whenever possible, spin assignments of the excited states of ^{70}Ge are given. (auth)

44639 ANALYSIS OF THE ELASTIC SCATTERING OF 14.5-MeV DEUTERONS ON ISOTOPES BETWEEN ^{54}Fe AND ^{124}Sn. Hjorth, S. A. (Univ. of Pittsburgh); Lin, E. K.; Johnson, A. Nucl. Phys., A116: 1-13(1968).

The differential cross sections for the elastic scattering of 14.5-MeV deuterons on 15 isotopes of eight elements between ^{54}Fe and ^{124}Sn were measured. The angular distributions were analyzed in terms of the optical model, and satisfactory fits were obtained in all cases by varying the depth of the real well and the three parameters which determine the imaginary well. The increase in the depth of the real well with Z and A is in rough agreement with theoretical expectation. The strength of the imaginary potential is related to the rigidity of the nuclear core. (auth)

44640 SELF-CONSISTENT PAIRING CALCULATIONS OF THE EVEN Ca ISOTOPES. Wolter, H. H. (Univ., Muenster, Ger.); Faessler, Amand; Sauer, P. U.; Stingl, M. M. Nucl. Phys., A116: 145-66(1968).

Hartree-Fock (HF) and Hartree-Fock-Bogolyubov (HFB) calculations were performed for the even Ca isotopes. The nucleon-nucleon interaction is the semi-realistic Brink-Boeker force L_4 and the Coulomb force, no core is split off and the nuclei are allowed to assume axially symmetric and reflection invariant deformations. In HFB, only proton-proton and neutron-neutron pairing is considered. For all nuclei except ^{40}Ca, two solutions, an oblate and a prolate one, are found; the prolate solution is the lowest in energy. Pairing among the pf-shell neutrons turns out to be rather pronounced in the oblate states due to a high level density at the Fermi surface, which lowers the energy, widens the gap and makes the nucleus more spherical; it is weaker in the prolate states. Moreover, systematic variations with neutron excess are investigated such as symmetry energy, deformations and changes in the mass and charge distributions. The latter were compared with those derived from electron scattering. Despite some overall agreement, discrepancies are found in the details of the distributions, which indicate that the force without a spin-orbit interaction is not adequate for these nuclei. (auth)

44641 THE NUCLIDE ^{50}Sc. Hughes, T. A. (IBM Scientific Center, Houston, Tex.); Soga, M. Contract AT(30-1)-3525. Nucl. Phys., A116: 33-42(1968). (NYO-3525-30).

The energy levels and wave functions of ^{50}Sc were calculated within the framework of the nuclear shell model using two-body matrix elements of both Soper and Rosenfeld mixture. The log ft for the β-decay of both ^{50}Ca and ^{50}Sc were computed. The agreement with experiment appears good. (auth)

44642 GAMMA RAYS FROM THE INTERACTION OF 14.1-MeV NEUTRONS. Martin, P. W.; Stewart, D. T. (Univ. of Glasgow). Can. J. Phys., 46: 1657-9(Aug. 1, 1968).

Gamma rays following the interaction of 14.1-MeV neutrons with natural samples of Na, Mg, S, Si, Mn, and Fe were studied using an associated-particle time-of-flight technique. The analysis has revealed several previously unreported gamma rays following neutron scattering and neutron-induced reactions. Assignments were made for the possible reaction processes and transition modes. (auth) (CANADA)

44643 A STUDY OF THE 4.509-MeV STATE IN ^{27}Al BY THE ^{26}Mg(p,γ) REACTION. Roepke, H.; Lam, S. T. (Univ. of Toronto). Can. J. Phys., 46: 1649-55(Aug. 1, 1968).

The 4.509-MeV state in ^{27}Al was investigated using the ^{26}Mg(p,γ) reaction at the $E_p = 2.174$-MeV resonance. On the basis of γ-ray angular distributions, the spin-parity assignment of the resonance ($E_x = 10.366$ MeV) was found to be $\frac{7}{2}^+$ and strong evidence was given that the 4.509-MeV state in ^{27}Al has $J^\pi = \frac{11}{2}^+$. The lifetime was found to be $\tau(4.509) = 340$ fs ± 10%. The 8.040-MeV state in ^{27}Al had a spin-parity assignment of $\frac{7}{2}^+$. Branching ratios were given for the resonance as well as levels above the 4.509-MeV state fed by the resonance. (auth) (CANADA)

44644 VARIATIONAL CALCULATION OF NUCLEAR BINDING ENERGIES. Pandharipande, V. R. (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys., A115: 516-20(1968).

It is shown that the interaction energy of a nuclear system interacting with a central Yukawa plus a velocity-dependent δ-function two-body interaction can be reasonably approximated as a function of the local densities. The resulting expressions bear general resemblance with the Weiszsacker semi-empirical mass law. A simple variational calculation is carried out with these expressions for the ^{4}He, ^{16}O, ^{40}Ca, and ^{56}Ni nuclei and nuclear matter. The calculated binding energies and radii are in excellent agreement with the experimental data. (auth)

44645 INELASTIC SCATTERING OF 52-MeV DEUTERONS. Hinterberger, F. (Univ., Bonn); Mairle, G.; Schmidt-Rohr, U.; Wagner, G. J.; Turek, P. Nucl. Phys., A115: 570-92(1968).

Strongly excited levels of the nuclei ^{12}C, ^{14}N, ^{20}Ne, ^{22}Ne, ^{27}Al, ^{28}Si, ^{32}S, ^{40}Ar, ^{48}Ti, ^{54}Fe, ^{58}Ni, ^{64}Ni, ^{208}Pb, and ^{209}Bi were investigated by means of inelastic scattering of 52-MeV deuterons. The angular distributions were analyzed in terms of the DWBA. The description of the excited states in the collective model yields good fits and values of the deformation parameter β_L which agree with independent measurements. Satisfactory fits are obtained in an attempt to apply a microscopic theory of inelastic deuteron scattering. An effective nucleon-nucleon interaction of Wigner type $V(r) = V_N \exp(-r^2/\gamma^2)$ is assumed to induce the scattering. From target nuclei where shell-model wave functions for the ground and excited states are available, the parameters $V_N = 38 \pm 5$ MeV and $\gamma = 1.7$ fm are deduced. For other target nuclei, information about the collective enhancement of the excited states is obtained which is more sensitive to the details of the nuclear structure than the β_L values. (auth)

44646 NUCLEAR BINDING ENERGY SYSTEMATICS INCLUDING EXCITED STATES FOR $T_z = 0$ AND $\frac{1}{2}$ NUCLEI WITH $A \leq 61$. Everling, F. (North Carolina State Univ., Raleigh. Duke Univ., Durham, N. C.). Nucl. Phys., A115: 563-9(1968). (ORO-3624-4).

The total nuclear binding energies B (in MeV) of ground states and certain excited states are plotted versus the mass number A in the form $-B + (9\text{ MeV})A$ for self-conjugate nuclei and those having $T_z = \frac{1}{2}$ for $A \leqq 61$. The trends of the 0^+ ground states of self-conjugate nuclei and the $\frac{5}{2}^+$ and $\frac{7}{2}^-$ states of $T_z = \frac{1}{2}$ nuclei show analogies between the $1d_{5/2}$ and $1f_{7/2}$ shells. The four trends within these shells are smooth except that their beginnings (^{16}O, ^{17}O, ^{40}Ca, and ^{41}Ca) lie several MeV lower. These steps, occurring near the harmonic oscillator shell magic numbers Z, N = 8 and 20, are in contrast to breaks at Z, N = 14 and 28. Whereas the traditional consideration of separation energies obscures the magic number 14, these diagrams show the effect of Z,N = 14 in $^{28}_{14}\mathrm{Si}_{14}$ and $^{29}_{14}\mathrm{Si}_{15}$ very clearly. (auth)

44647 SPECTROSCOPIC ANALYSIS OF THE (p,2p) REACTION ON THE NUCLEI ^{28}Si, ^{24}Mg, AND ^{23}Na. Jain, B. K. (Univ. of Surrey, London). Nucl. Phys., A116: 256-70(1968).

The data on the (p,2p) reaction on the nuclei ^{28}Si, ^{24}Mg, and ^{23}Na at an incident energy of 156 MeV are analyzed in terms of spectroscopic factors, and a comparison is made with theoretical predictions from SU$_3$ and collective model coupling schemes. (auth)

44648 RESIDUAL NEUTRON-PROTON INTERACTION IN THE NUCLEI ^{38}Cl AND ^{40}K. Rudak, E. A. (Inst. of Physics, Minsk). Yadern. Fiz., 7: 1190-2(June 1968). (In Russian).

Experimental values of the differences of the matrix elements of the residual neutron–proton interaction in the nuclei ^{38}Cl and ^{40}K were used to estimate the potential parameters for the central and the tensor interaction. (auth)

44649 TOTAL CROSS SECTIONS FOR 14.7-MeV NEUTRONS. Gomma, M. A.; Nicholson, P. W. J. Phys., D, 1: 1091-2(Aug. 1968).

Total neutron cross sections are reported for the following elements: C, Al, S, Cr, Mn, Fe, Ni, Cu, Zn, Cd, Hg, and Pb. Values for water and tissue-equivalent material are also reported. (auth) (UK)

44650 CALCULATIONS OF INELASTIC INTERACTIONS OF COSMIC NUCLEI. Barashenkov, V. S.; Gudima, K. K.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 352-3(Mar. 1968). (In Russian).

Deuteron reactions with nuclei were studied using the Monte Carlo method within the limits of the cascade-evaporation model, taking into account stripping and Coulomb effects and diffraction deuteron spallation. Cross sections of inelastic deuteron–nucleus interactions (for Al, Cu, Ta, Pb, Bi, and U) at a deuteron energy of 160 MeV are tabulated. Distribution of the prongs in stars formed by deuterons in photoemulsion at 175 MeV and the width of angular distribution of neutrons formed by deuteron interactions with Al, Ta, Pb, and U at 190 MeV are also tabulated. The preliminary data on α particle–nucleus interactions showed that in such an event the inelastic interactions are determined by a mechanism of intranuclear cascades. (R.V.J.)

44651 INELASTIC SCATTERING OF 17.5-MeV PROTONS FROM ^{44}Ca, ^{45}Sc, AND ^{46}Ti. Peterson, R. J.; Perlman, D. M. (Princeton Univ., N. J.). Nucl. Phys., A117: 185-207(1968).

The elastic and inelastic scattering of 17.5-MeV protons from ^{44}Ca, ^{45}Sc, and ^{46}Ti was studied. The results for excitation energies, spin assignments, and deformation distances βR for the excited states of the even nuclei are consistent with those from inelastic alpha-particle scattering. Attempts to understand the results for ^{45}Sc in terms of simple nuclear models were not successful, but much information to guide further interpretations of this nucleus was obtained. (auth)

44652 A COMMENT ON LEUTZ AND WENNINGER'S PAPER ON THE ^{22}Na BRANCHING RATIO. Williams, A. (National Physical Lab., Teddington, Eng.). Nucl. Phys., A117: 238(1968).

It is pointed out that exchange and overlap effects only alter the theoretical value of the ratio of electron capture to positon emission in the decay of ^{22}Na by less than 1 part in 10^3. They can not therefore, as was claimed by Leutz and Wenninger, account for the difference between the theoretical value 0.1138 ± 0.0025 and the mean of recent experimental values 0.1045 ± 0.0007. (auth)

44653 ABSOLUTE MEASUREMENTS OF HIGH ENERGY X-RAY BEAM ENERGY AND PHOTONEUTRON CROSS SECTIONS FOR NATURAL COPPER AND LEAD. Tomimasu, Takio. Denki Shikenjo Kenkyu Hokoku, No. 679, 1-54(Dec. 1967).

Absolute determination of high-energy x-ray beam energy by cavity ionization chamber method has been described and absolute photoneutron cross sections for natural copper and lead have been determined with an ETL quantameter and a 4π neutron detector using the x-ray beam from an ETL 25 MeV betatron. The total beam energy U of the incident photons to a thick multiplate copper chamber is given by an absorbed energy U_A and a leakage energy U_L. U_A can be measured by cavity ionization chamber using stopping power ratios of copper to air and copper to argon. These ratios have been calculated in the energy region from 0.1 MeV to 1000 MeV by a new analytical method. To obtain correction factors for U_L, high energy x-ray albedo for copper and the lateral and longitudinal distributions of energy losses in the shower produced in a copper block were experimentally studied. A new type quantameter with good accuracy in the wide energy range has been designed. The total error in the calibration of the ETL quantameter is less than 1.9%. A replica of the NBS P2 chamber was calibrated by the ETL quantameter. It was found that the present calibration of the NBS P2 chamber is more smoothly varying with energy and about 3% higher than that given by NBS at energies below 18 MeV and agrees well with the calibration constants obtained by the use of calorimeters in NBS and LPTI at energies above 20 MeV. A calculated calibration of a quantameter filled with Ar + CO_2 mixture was also given and compared with experimental data. Peak photoneutron cross sections for natural Cu and Pb are 78 ± 8 mb at 17.2 MeV and 660 ± 60 mb at 14.1 MeV, respectively. These values are about 20% lower than the average cross section value obtained by several bremsstrahlung experiments. Integrated cross sections are 587 MeV-mb and 3910 MeV-mb from threshold to 24 MeV for Cu and to 23 MeV for Pb, respectively. σ_{-2} for Cu and Pb are 1.81 mb/MeV (from threshold to 24 MeV) and 18.6 mb/MeV (from threshold to 23 MeV), respectively. Considering the contribution of the (γ,p) cross section for Cu, the ratios of σ_{-2} to 0.00225 $A^{5/3}$ mb/MeV for Cu and Pb are 0.95 ± 0.14 and 1.13 ± 0.17, respectively. Comparison with previous results suggests that discrepancies are due to inaccuracies in absolute measurements of x-ray beam energy and photoneutrons or induced activities. (NSA of Japan)

44654 ABSORPTION OF GAMMA RAYS IN SILICON AND CALCIUM. Bezic, N.; Jamnik, D.; Kernel, G.; Krajnik, J.; Snajder, J. (Inst. Josef Stefan, Ljubljana, Yugoslavia). Nucl. Phys., A117: 124-8(1968).

The total absorption cross sections for gamma rays in the giant resonance region of silicon and calcium were measured. (auth)

44655 COLLECTIVE-MODEL ANALYSIS OF THE INELASTIC SCATTERING OF 49.5-MeV PROTONS BY ^{24}Mg. Rush, A. A. (King's Coll., London); Ganguly, N. K. Nucl. Phys., A117: 101-12(1968).

The inelastic scattering of 49.5-MeV protons by ^{24}Mg was analyzed using DWBA and SCA. A quadrupole deformation parameter of 0.49 was obtained from both SCA and DWBA when the nucleus was treated as a symmetrical rotator. When ^{24}Mg was considered to be an asymmetric nucleus, deformation parameters $\beta_2 = 0.37$ and $\beta_4 = 0.22$ were obtained with the asymmetry parameter $\gamma = 32°$. The adjustment of simple optical-model parameters for use in coupled-channels analysis of a rotational nucleus is discussed. (auth)

44656 ANGULAR DISTRIBUTIONS OF FAST PHOTONEUTRONS FROM THIRTEEN ELEMENTS, $23 \le Z \le 82$. Jury, J. W.; Hewitt, J. S.; McNeil, K. G. (Univ. of Toronto). Can. J. Phys., 46: 1823-6(Aug. 15, 1968).

The angular distribution of fast (>5 MeV) photoneutrons from V, Cr, Mn, Br, Mo, Ru, Rh, Pd, Sb, La, Pr, Pt, and Pb were measured at bremsstrahlung energies of about 22 MeV. The results expand and confirm previously noted variations of anisotropy with neutron occupation number, and in particular they confirm the peaking of the anisotropy at the closing of p and d subshells. (auth) (Canada)

44657 NUCLEAR REACTION SPECTROSCOPY WITH Ca AND Ti ISOTOPES. Hansen, Ole. Copenhagen, Univ. of Copenhagen, 1967. 63p.

Thesis.

The results of a series of experiments on nuclear reactions with Ca and Ti isotopes are summarized. Proton and deuteron ion beams from electrostatic generators were used. The reaction products were detected at 24 different angles simultaneously by the aid of multi-angle spectrographs. In an attempt to analyze quantitatively the experimental results, the distorted-wave method is used. After a comparison with more special models, it is concluded that ^{48}Ca seems much better suited to represent an inert, doubly closed shell nucleus than does ^{40}Ca. (Denmark)

44658 NUCLEAR-REACTION STUDIES IN THE STRONTIUM ISOTOPES: NEUTRON PARTICLE-HOLE STATES IN ^{88}Sr AND THE ^{87}Sr(d,p)^{88}Sr REACTION. Cosman, E. R.; Slater, D. C. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 172: 1126-33(Aug. 20, 1968).

The levels of ^{88}Sr were studied with the ^{87}Sr(d,p)^{88}Sr reaction at a bombarding energy of 7.5 MeV using the MIT-ONR Van de Graaff generator and multiple-gap spectrograph. Seventy-three levels below 8.516-MeV excitation were observed, 32 of which displayed direct-stripping angular distributions. A distorted-wave Born-approximation analysis for the latter transitions was performed, and the values of the transferred orbital angular momentum l_n and spectroscopic strengths $(2J + 1)S_{l_n,j}/(2J_0 + 1)$ were extracted. Sum-rule strengths were subsequently calculated and were compared with shell-model limits. Locations of neutron particle-hole state multiplets were determined and compared with a simple model involving single-particle neutron states, determined from the ^{88}Sr(d,p)^{89}Sr reaction, weakly coupled to a single $1g_{9/2}$ hole in the major N = 50 shell. A comparison of the data is made with the previously known level structure of ^{88}Sr. (auth)

44659 ENERGY LEVELS IN ^{89}Y. Hinrichsen, P. F. (Franklin Inst., Swarthmore, Pa.); Shafroth, S. M.; Van Patter, D. M. Phys. Rev., 172: 1134-8(Aug. 20, 1968).

Bound levels in ^{89}Y were studied up to 4.2-MeV excitation using a broad-range magnetic spectrograph. Examination of inelastic proton spectra at $E_p = 9.06$ and 9.98 MeV and with 15-keV resolution revealed several new levels, including closely spaced multiplets not previously detected. Of special interest are a doublet at 2879, and 2890 keV and a triplet of levels at 3075, 3114, and 3146 keV, each of which had been considered as a single level in prior experiments. Thus an explanation for many of the conflicting reports concerning these levels is now provided. (auth)

44660 PROTON-INDUCED REACTIONS ON ^{40}Ar AND ANALOGS OF ^{41}Ar LEVELS. Scott, H. L.; Galati, W.; Weil, J. L.; McEllistrem, M. T. (Univ. of Kentucky, Lexington). Phys. Rev., 172: 1139-48(Aug. 20, 1968).

Excitation functions were measured at several angles between 58 and 161° for the ^{40}Ar (p,p) ^{40}Ar, ^{40}Ar (p,p′) ^{40}Ar* (first excited level), and ^{40}Ar (p,α) ^{37}Cl reactions. Differential cross sections were measured in 3-keV steps with an energy resolution of 3 keV for incident proton energies from 1.81 to 4.35 MeV. The structures observed in the proton inelastic scattering yields and α-particle yields were not completely resolved. Averaging the cross sections with an interval of ~25 keV revealed a residual resonance structure with widths and spacings between 10 and 40 keV, interpreted as analog resonances. Seventeen resonances are included in an analysis of the averaged cross sections for proton elastic and inelastic scattering. Eight of these correspond to known levels of ^{41}Ar. Reduced proton widths of the eight analogs imply neutron spectroscopic factors for bound levels of ^{41}Ar in agreement with those extracted from an analysis of the ^{40}Ar (d,p) ^{41}Ar reactions. (auth)

44661 PRECISE ENERGIES OF ^{40}Ca LEVELS. Kashy, E.; Snelgrove, J. L. (Michigan State Univ., East Lansing). Phys. Rev., 172: 1124-6(Aug. 20, 1968).

Energies of excited levels of ^{40}Ca were measured with high precision using a Ge(Li) detector to observe γ-ray transitions. The present work, which resolves some discrepancies in the literature, yields $E_x = 3737.1 \pm 0.3$ keV for the lowest 3^- level and $E_x = 7658.9 \pm 0.5$ keV for the ^{40}Ca T = 1 analog of the ^{40}Sc ground state. Energies of a number of other levels of ^{40}Ca are also given. (auth)

44662 LIFETIMES, ENERGIES, AND BRANCHING RATIOS OF ^{28}Si EXCITED STATES. Gibson, E. F.; Battleson, K.; McDaniels, D. K. (Univ. of Oregon, Eugene). Phys. Rev., 172: 1004-13(Aug. 20, 1968).

The γ decay of ^{28}Si energy levels excited in the ^{27}Al(p,γ)^{28}Si reaction was investigated with a 20-cm^3 Ge(Li) detector. Energies of levels below 7 MeV were measured to an accuracy of <1 keV by comparison with the ^{56}Co spectrum. The 6878-keV 3^- and 6889-keV 4^+ doublet is found to be split by 10.9 ± 0.5 keV; decay of the 6878-keV state to the 4617-keV level was definitely established. Several branching ratios were measured for the first time, or with improved accuracy. Mean lifetimes of excited states were derived from observed γ-ray Doppler shifts, with the following results: 4617 keV (0.061 ± 0.004 psec), 7380 keV (0.013 ± 0.003 psec), 7416 keV (0.040 ± 0.003 psec), 8260 keV (0.014 ± 0.006 psec), 8588 keV (0.025 ± 0.005 psec), 9163 keV (0.039 ± 0.005 psec), 9316 keV (<0.01 psec), and 10 213 keV (0.015 ± 0.007 psec); previously published lifetimes were confirmed for levels at 1779, 6276, 6878, 7798, and 8413 keV. A probable spin-parity assignment of 2^+ is made for the 9163-keV state. The small E2 transition strengths from the level at 7416 keV to the ground and first excited states are consistent with Hartree–Fock predictions that this is the 2^+ member of a rotational band whose ground state is the 6.68 (0^+) level. (auth)

44663 TWO-PARTICLE, TWO-HOLE STATES IN ^{40}K FROM THE STUDY OF THE ^{40}Ar(^{3}He,^{3}H)^{40}K REACTION. Wesolowski, J. J.; Hansen, Luisa F.; Stelts, M. L. (Univ. of California, Livermore). Phys. Rev., 172: 1072-7(Aug. 20, 1968). (UCRL-70964).

Differential cross sections for the ^{40}Ar(^{3}He,^{3}H)^{40}K reaction were measured for a ^{3}He bombarding energy of 17.9 MeV. A comparison is made between the ^{40}Ar(^{3}He,^{3}H)^{40}K data and the ^{39}K(d,p)^{40}K data of Enge et al. to determine the location of some of the two-particle, two-hole states in ^{40}K. The angular distributions of 10 triton groups were obtained. Distorted-wave Born-approximation (DWBA) calculations were compared with some of these distributions to demonstrate the consistency of spin assignments. (auth)

44664 (p,d) REACTION ON N = Z NUCLEI IN THE 2s-1d SHELL. Kozub, R. L. (Michigan State Univ., East Lansing). Phys. Rev., 172: 1078-94(Aug. 20, 1968).

An investigation of the (p,d) reaction on N = Z nuclei in the 2s-1d shell was made to obtain spectroscopic information and to study the $l_n = 2$ J-dependence for the (p,d) reaction. The experiments were performed with ^{24}Mg, ^{28}Si, ^{32}S, ^{36}Ar, and ^{40}Ca as target nuclei, and virtually all of the 2s-1d shell hole strength was observed. Deuteron angular distributions for strongly excited levels in ^{23}Mg, ^{27}Si, ^{31}S, ^{35}Ar, and ^{39}Ca were measured for laboratory angles from 10° to 155°, and spectroscopic factors were obtained using distorted-wave Born-approximation (DWBA) calculations. The J dependence for the pickup of an $l_n = 2$ neutron appears mostly in the forward angles of the angular distributions and seems to follow systematic trends through the 2s-1d shell, thus suggesting spin assignments for levels in ^{31}S, ^{35}Ar, and ^{39}Ca. Appreciable configuration mixing is found to exist in the ground-state wave functions of all the nuclei investigated. Of particular interest are the $l_n = 1$ levels excited in the $^{24}Mg(p,d)^{23}Mg$ and $^{28}Si(p,d)^{27}Si$ reactions, which could arise from the removal of either 1p- or 2p-shell neutrons. The ground states of ^{36}Ar and ^{40}Ca are observed to contain appreciable mixing with the $f_{7/2}$ shell, and evidence exists for a small $[2p]^2$ admixture in the ^{40}Ca ground state. The level orders of the residual nuclei and the DWBA spectroscopic factors are discussed in terms of the strong-coupling rotational model and Nilsson-model wave functions. Evidence for strong rotational band mixing is apparent in many cases. (auth)

44665 EXCITATION FUNCTIONS FOR RADIOACTIVE ISOTOPES PRODUCED BY PROTON-INDUCED REACTIONS IN SILICON. Sheffey, D. W. (Univ. of Tennessee, Knoxville); Williams, I. R.; Fulmer, C. B. Phys. Rev., 172: 1094-8(Aug. 20, 1968).

Cross sections were measured for the production of radioactive nuclides by proton-induced reactions in natural silicon at bombarding energies below 60 MeV. Stacked wafers of target material were bombarded with cyclotron-accelerated protons. γ spectra of individual foils were subsequently measured with a Ge(Li) spectrometer. Excitation functions were obtained for ^{28}Al, ^{29}Al, ^{27}Mg, ^{22}Na, ^{24}Na, ^{18}F, and ^{7}Be. Cross sections predicted by an evaporation theory are in reasonable agreement with the experimental values. (auth)

44666 ANALYSIS OF TWO-NEUTRON (L = 0) TRANSFER CROSS SECTIONS FOR CALCIUM AND NICKEL. Bayman, B. F.; Hintz, Norton M. (Univ. of Minnesota, Minneapolis). Phys. Rev., 172: 1113-23(Aug. 20, 1968).

An attempt was made to determine whether experimental data on L = 0 (t,p) and p,t) reactions on the even calcium and nickel isotopes are consistent with a reasonable amount of configuration mixing and a distorted-wave Born-approximation treatment of the two-neutron transfer process. The calcium calculation involves the six shells from $2s_{1/2}$ through $1f_{5/2}$; the nickel calculation involves the five shells from $1f_{7/2}$ through $1g_{9/2}$. The configuration mixing was simulated by diagonalizing a pairing force between seniority-zero states. The calculated eigenstates are consistent with one-particle transfer data, and give a satisfactory account of the ratios of observed (t,p) and (p,t) cross sections for ground-state transitions. However, certain excited calcium states seen in the (t,p) reaction are predicted to be populated with about twice the observed cross section. These states must involve more complicated degrees of freedom than the seniority-zero components we have included. Calculated (t,p) angular distributions are in good agreement with the experimental data. Calculated (p,t) angular distributions are about 5° out of phase with the experimental data. (auth)

44667 $^{40}Ar(p,n)^{40}K$ REACTION FROM THRESHOLD TO 5.0 MeV. Young, T. M.; Brandenberger, J. D.; Gabbard, F. (Univ. of Kentucky, Lexington). Phys. Rev., 172: 1148-52(Aug. 20, 1968).

Excitation functions were obtained for the reaction $^{40}Ar(p,n)^{40}K$ from threshold to 5 MeV. For bombarding energies between threshold and 3.7 MeV, a long counter was used to measure the total cross sections and the differential cross sections at 0 and 90°. Between proton bombarding energies of 3.3 and 5.0 MeV, time-of-flight techniques were used to measure the excitation functions at 0° for two neutron groups. Pronounced resonant structure was observed throughout the proton energy range. The results are compared with expected energies for isobaric analogs of states in ^{41}Ar. Neutron partial widths are given for selected resonances. (auth)

44668 INELASTIC SCATTERING OF 42-MeV ALPHA PARTICLES FROM ^{39}K AND ^{51}V. Peterson, R. J. (Univ. of Washington, Seattle. Princeton Univ., N. J.). Contract AT(30-1)937. Phys. Rev., 172: 1098-1112(Aug. 20, 1968). (PUC-937-290).

The results of a study of the inelastic scattering of 42-MeV α particles from the odd nuclei ^{39}K and ^{51}V are compared with the predictions of the shell model and the weak-coupling collective model. The results of a variety of other experiments are correlated with the present results whenever possible in order to test the predictions of the two models. Some success is found for various states with each model, and, in particular, the 3.60- and 3.90-MeV states of ^{39}K are assigned spins of $9/2^-$ and $7/2^-$ on the basis of the weak-coupling model, while spins of $3/2^-$ and $5/2^-$ are suggested for two states near 4.14 MeV. Good agreement with the data for ^{51}V is found by using the shell-model prediction with the L = 2 cross sections enhanced by a factor of 4. (auth)

44669 SPIN ASSIGNMENT OF THE 8.555-MeV STATE IN ^{28}Si. Nomura, T.; Povh, B. (Max-Plank-Institut fuer Kernphysik, Heidelberg. Univ., Heidelberg). Z. Phys., 215: 91-4 (1968).

Angular correlations between the gamma rays following the decay of the 8.555-MeV state in ^{28}Si, known to have natural parity, were measured. The spin assignment of this state, found in this experiment, is $J^\pi = 6^+$. The energy sequence of the lowest $J^\pi = 2^+$, 4^+, and 6^+ states in ^{28}Si compares well with the energy sequence of the ground state rotational bands in ^{20}Ne and ^{24}Mg. (auth)

44670 ENERGY LEVELS IN ^{46}Ti. Erlandsson, B.; Marcinkowski, A. (Univ. of Lund, Sweden). Z. Phys., 215: 39-55 (1968).

The gamma-ray spectra of several resonances in the $^{45}Sc(p,\gamma)^{46}Ti$ reaction were measured using a 5-cm^3 Ge(Li) detector. A thick target was bombarded with 1377- and 1660-keV protons; several resonances were therefore excited at each proton bombarding energy. The decay and energy of 30 excited levels were investigated. The intensity of all transitions to the ground state agrees within an error of about 9% with the total intensity of all transitions starting from the proton capture states, which indicates that low-energy transitions between high-excited levels are of no importance. A theoretical primary gamma-ray spectrum that fits the experimental averaged spectrum rather well was calculated. (auth)

44671 DETERMINATION OF THE NUCLEAR QUADRUPOLE MOMENT OF ^{57m}Fe FROM α-Fe_2O_3 DATA. Artman, J. O. (Carnegie-Mellon Univ., Pittsburgh); Muir, A. H. Jr.; Wiedersich, H. Phys. Rev., 173: 337-43(Sept. 10, 1968).

A new value for the nuclear quadrupole moment $Q(^{57m}Fe)$ of the 14.4-keV level of ^{57}Fe based on α-Fe_2O_3 data was determined from a detailed series of Moessbauer-effect quadrupole-interaction measurements, x-ray structure-parameter studies, and lattice-sum calculations (including dipole moments). At room temperature, $e^2qQ = +0.880 \pm 0.024$ mm/sec. This, when combined with the principal component of the electric field gradient tensor at the iron-ion site ($+4.910 \pm 10^{13}$ esu), yields $Q(^{57m}Fe) = +0.283 \pm 0.035$ b. The calculated field gradient is very sensitive to slight variations in the α-Fe_2O_3 structure parameters, particularly so for the iron special position parameter. A careful analysis has been made of the uncertainty in the quadrupole moment determination, although the effects of covalency and quadrupole (and higher-order) polarizability have not been included. It was also found that the thermal history of the samples can influence significantly the measured quadrupole coupling constant. The present result is compared to other quadrupole moment determinations. (auth)

44672 SPIN FLIP IN THE INELASTIC SCATTERING OF 30- AND 40-MeV PROTONS BY ^{28}Si. Ginaven, R. O.; Gross, E. E.; Malanify, J. J.; Zucker, A. (Oak Ridge National Lab., Tenn.). Phys. Rev. Lett., 21: 552-4(Aug. 19, 1968).

Proton spin flip in excitation of the first 2^+ state in ^{28}Si was determined at 29.7 and 40.0 MeV by measuring the correlation between inelastically scattered protons and gamma rays emitted normal to the scattering plane. The data are well described by the distorted-wave Born-approximation collective model when the deformed spin-dependent potential has the full Thomas form. (auth)

44673 CORE EXCITATION IN THE REACTION $^{65}Cu(t,\alpha)^{64}Ni$. Heymann, G. (Council for Scientific and Industrial Research, Pretoria). Phys. Lett., 27B: 280-2(Aug. 5, 1968).

The strong excitation of the 5^- state in the reaction $^{65}Cu(t,\alpha)^{64}Ni$, which is forbidden by direct single-proton pickup, is used as evidence for a two-step process in this pickup reaction. (auth)

44674 NEUTRON CAPTURE CROSS-SECTION MEASUREMENT BY RADIOACTIVE NUCLEI ^{58m}Co, ^{64}Cu, AND ^{46}Sc. Kondurov, I. A.; Egorov, A. I.; Kaminker, D. M.; Korotkikh, E. M.; Nikitin, A. M. At. Energ. (USSR), 24: 533-40(June 1968). (In Russian).

The resonance integral ($760 \pm 160 \times 10^3$ barn) and thermal neutron capture cross section ($136 \pm 10 \times 10^3$ barn) of ^{58m}Co were measured. The limit of the effective capture cross section of ^{64}Cu

($\sigma < 6000$ barn) was found, and the effective capture cross section of ^{46}Sc was measured. Estimation is carried out on a possible reactor poisoning due to the neutron capture by ^{58m}Co nuclei that can be formed in (n,p) reactions on the structural nickel and by ^{64}Cu nuclei in ^{63}Cu (n,γ) reaction. The ^{46}Sc burnout was calculated for using the ^{46}Ti (n,p) reaction for fast neutron monitoring. (auth)

44675 CONSIDERATION OF EXCHANGE INTERACTION IN INELASTIC NEUTRON SCATTERING BY EVEN–EVEN NUCLEI. Korolev, A. M.; Konstantinov, B. D. (Kiev Inst. of Physics). Ukr. Fiz. Zh., 13: 965-74(June 1968). (In Russian).

Inelastic neutron scattering by even-even nuclei is considered in the Born approximation on the basis of the following simple model. The target nucleus is supposed to consist of an even-even core and one or two extra-pairs in a bound s-state. The transition operator consists of the term describing the direct interaction of a falling neutron with the pair neutrons and the exchange interaction which in principle is similar to that with allowance for the Pauli principle in the system under consideration. Angular distributions of the scattered 14-MeV neutrons obtained as a result of theoretical calculations are compared with the experimental results for scattering by ^{40}Ca, Ni, and Zn nuclei with two parameters of the theory. Comparing theoretical and experimental results, one can conclude that the pair model with allowance for exchange effect and with suitable choice of parameters is in good agreement with the experiment when the levels $J^\pi = 3^-$ are excited in case of scattering by ^{40}Ca and Zn nuclei. Though the angular distributions obtained theoretically with the excitation of the $J^\pi = 2^+$ levels give satisfactory agreement with the experiment, providing the angles of scattering are small or large, discrepancy with the experiment is observed in the range of angles from 60 to 80°. (auth)

44676 BRANCHING RATIOS OF ^{27}Al BOUND STATES. Elliott, R. V.; Ophel, T. R.; Spear, R. H. (Australian National Univ., Canberra). Nucl. Phys., A115: 673-82(1968).

A 12.7 cm × 10.2 cm NaI(Tl) gamma-ray spectrometer was used in conjunction with a 61 cm magnetic particle spectrometer to measure gamma-ray branching ratios for bound states of ^{27}Al at excitation energies of 2.21, 2.73, 2.98, 3.00, 3.68, 3.96, 4.05, 4.41, 4.51, and 4.58 MeV. (auth)

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Refer also to abstracts 42587, 42588, 42698, 43080, 43109, 43665, 43666, 44452, 44608, 44619, 44628, 44639, 44645, 44649, 44653, 44772, 44774, 44781, and 44799.

44677 (AAEC/TM–443) DETERMINATION OF THE THERMAL NEUTRON CAPTURE CROSS SECTION OF ^{148}Sm. Whittem, R. N. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Mar. 1968. 9p. Dep.

The thermal neutron capture cross section of ^{148}Sm was measured by mass spectrometer abundance measurements before and after irradiation of an isotopically enriched sample of ^{148}Sm. A value of 4.73 ± 0.11 barns was found. (auth)

44678 (ANL-Trans–633) SYNTHESIS AND INVESTIGATION OF PROPERTIES OF ISOTOPES OF TRANSURANIUM ELEMENTS. Flerov, G. N.; Donets, E. D.; Druin, V. A.; Lobanov, Yu. V.; Mikheev, V. L.; Polikanov, S. M.; Shchegolev, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from pp 3-14 of JINR–D7-3548. 14p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 18208. (TSS)

44679 (IAN-E-1) RELATION OF THE EFFECTIVE CROSS SECTION OF THE PAIR OF ISOMERS ^{191m}Os, ^{191}Os OBTAINED BY MEANS OF THE NUCLEAR REACTION ^{190}Os(n,γ)^{191}Os. Carrillo P., Lila; Nino V., Luis C. (Instituto de Asuntos Nucleares, Bogota (Colombia). Seccion Espectroscopia). Sept. 1964. 12p. (In Spanish). Dep.

The ratio for the formation of the isomeric pair ^{191m}Os, ^{191}Os was measured beginning with the activation of a sample of metallic Os with thermal neutrons. The measurements were made by scintillation techniques. The results showed that the isomeric state ^{191m}Os of spin $^3/_2$ is formed in greater proportion than the isomeric state ^{191}Os of spin $^9/_2$. (tr-auth)

44680 (IN–1189) BURNUP DETERMINATION OF NUCLEAR FUELS. Project Report, July 1–September 30, 1967. Lisman, Frederick L.; Maeck, William J.; Rein, James E. (eds.). (Idaho Nuclear Corp., Idaho Falls). July 1968. Contract AT(10-1)-1230. 50p. Dep. CFSTI.

The thermal fission yields of Ba, Ce, Cs, Kr, Nd, Rb, Sr, Xe, and Zr isotopes from ^{239}Pu were determined using isotope dilution mass spectrometry. The effective capture-to-fission ratio for ^{239}Pu was also measured. (D.C.W.)

44681 (IS-T–234) THE RADIOACTIVE DECAY OF ^{91}Sr. Solecki, James Edward (Ames Lab., Iowa). May 1968. Contract W-7405-eng-82. 38p. Dep. CFSTI.

Thesis.

A high-resolution Ge(Li) spectrometer was employed to study the gamma rays associated with the beta decay of ^{91}Sr. An isotopically pure source was produced by the decay of a sample of ^{91}Kr provided by the on-line isotope separator system. Energies and relative intensities of twenty-one gamma rays were measured. The energies of the strong gamma rays were determined to within ±0.1 keV, an order of magnitude improvement in accuracy over the previously reported data. Gamma–gamma coincidence measurements were performed to verify some of the cascade transitions. From these data and the results of studies at other laboratories of the beta spectrum of ^{91}Sr, the ^{92}Zr(d,^{3}He) reaction, and the ^{89}Y(t,p) reactions, a decay scheme of ^{91}Sr and an energy-level diagram for ^{91}Y were deduced. The half-lives of ^{91}Sr and the isomeric state in ^{91}Y were measured to be 9.48 ± 0.01 hr and 49.71 ± 0.04 min, respectively. (auth)

44682 (JINR–E6-3905) DIRECTIONAL CORRELATIONS OF GAMMA CASCADES IN ^{160}Dy. Hrynkiewicz, A. Z.; Styczen, J.; Szeglowski, Z.; Walus, W. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1968. 10p. Dep.

Directional correlation measurements were performed for the following gamma cascades in ^{160}Dy: 1178 keV – 87 keV, 1272 keV – 87 keV, 1003 keV – 197 keV, 1115 keV – 197 keV, 299 keV – 879 keV, and 299 keV – 966 keV. Obtained results corroborate the spin assignments I = 2 for the 1264 and 1358 keV states and I = 3 for the 1286 keV state. For the 1386 keV state, I = 4 was established. The existence of the 872 keV transition was confirmed and its absolute gamma intensity was determined as 0.24(6)%. (auth)

44683 (JINR–E6-3992) THE ALPHA DECAY OF ^{245}Cf. Kusch, W.; Szeglowski, Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1968. 11p. Dep.

The α spectrum of the isotope ^{245}Cf was investigated using a surface-barrier semiconductor detector. Besides the main α group, four groups with low intensities were observed. An attempt was made to compare the α energy with those of rotational bands built on the Nilsson states, which are known in this region of neutron numbers. (auth)

44684 (UJV–2036) THE DECAY OF ^{131}La. Spalek, A.; Rezanka, I.; Frana, J.; Jursik, J.; Vobecky, M. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). May 1968. 26p. Dep.

The decay of ^{131}La ($T_{½}$ = 61 min) was investigated by means of Ge(Li) and Si(Li) spectrometers and Ge(Li)–NaI(Tl) coincidences. The decay scheme for ^{131}La is presented including four new levels. Of the two possibilities for ^{131}La ground state spin, $^1/_2$ or $^3/_2$, the former value is preferred. The results are discussed in terms of analogies with neighboring nuclei. (auth)

44685 FLUORESCENCE YIELDS IN THE L SHELL OF PROTACTINIUM. Boyer, P.; Barat, J. L. (Institut des Sciences Nucleaires, Grenoble, France. Centre d'Etudes Nucleaires, Grenoble, France). Nucl. Phys., A115: 521-8(1968). (In French).

The L-internal conversion of a 58.5-keV transition in ^{231}Pa is used to study the L-subshell fluorescence yields. Electron–photon coincidence measurements performed with an electrostatic spectrometer, give the mean L-shell fluorescence yield for the mentioned transition and the ratio of the L_{II} and L_{III} subshells fluorescence yields. The values $\bar{\omega}_L^{58.5} = 0.50 \pm 0.04$ and $\omega_2/\omega_3 = 1.206 \pm 0.013$ were obtained. Taking into account the multipolarity of the 58.5-keV transition, from these experimental values $\omega_2 = 0.55 \pm 0.06$ and $\omega_3 = 0.46 \pm 0.05$ are obtained. The agreement is good with the semi-theoretical values of Listengarten. (auth)

44686 DECAY SCHEME OF 13.3-hr ^{123}I. Ragaini, R. C.; Walters, W. B.; Gordon, G. E.; Baedecker, P. A. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-905. Nucl. Phys., A115: 611-24(1968).

The decay scheme of 13.3-hr ^{123}I to levels of ^{123}Te was determined with the use of Ge(Li) and NaI(Tl) γ-ray detectors and coincidence equipment. Sources were produced by the ^{121}Sb(α,2n)^{123}I reaction. A total of 14 γ rays was observed and placed in the decay scheme. Excited states of ^{123}Te were established at 159, 248 (117 d ^{123m}Te), 440, 506, 688, 698, 784 and 895 keV. The upper limit for positron decay of ^{123}I is 0.01%. The $^{11}/_2^-$ isomer ^{123m}Te is fed in 0.010 ± 0.005% of the decays of ^{123}I. The levels of ^{123}Te are fitted considerably better by the recent predictions by Kisslinger and Kumar than by the older calculations of Kisslinger and Sorensen. (auth)

44687 STUDY OF THE DECAY OF 17.9-DAY ^{74}As. Kukoc, A. H.; King, J. D.; Taylor, H. W. (Univ. of Toronto). Nucl. Phys., A115: 625-34(1968).

The decay of 17.9-day ^{74}As was investigated using a 5 cm^3 Ge(Li) detector and a conventional Ge NaI coincidence system. Gamma rays with energies (intensities) of 595.86 ± 0.14 (100), 608.4 ± 0.2 (1.0), 634.73 ± 0.15 (25.6), 887.2 ± 0.7 (0.048), 993.6 ± 0.8 (0.021), 1204.6 ± 0.4 (0.47), 1604.0 ± 1.0 (0.013), and 2198.8 ± 1.0 (0.019) keV were observed. Evidence from coincidence measurements suggest an additional gamma ray with an energy of 634 ± 1 keV. Revised level schemes for both ^{74}Ge and ^{74}Se incorporating all the observed transitions were deduced. (auth)

44688 ENERGY LEVELS IN ^{154}Dy. Ward, David; Neiman, M. (Univ. of California, Berkeley). Nucl. Phys., A115: 529-39(1968).

A level scheme for ^{154}Dy is proposed from study of the β-decay of ^{154}Ho, and from the "in-beam" gamma spectrum of the reaction ^{139}La(^{19}F,4n)^{154}Dy. The ground-state quasi-rotational band is observed up to spin 10^+ in the reaction, and up to 8^+ in the β-decay. It is proposed that the other levels observed in the β-decay may be understood as a quasi β-vibrational band. (auth)

44689 THE (d,^{3}He) REACTION ON ^{126}Te, ^{128}Te, AND ^{130}Te NUCLEI. Auble, R. L.; Ball, J. B.; Fulmer, C. B. (Oak Ridge National Lab., Tenn.). Nucl. Phys., A116: 14-26(1968).

The (d,^{3}He) reaction was employed to study the shell-model composition of the ground states of ^{126}Te, ^{128}Te and ^{130}Te. The study was performed with a 34-MeV deuteron beam from the Oak Ridge Isochronous Cyclotron. A silicon counter telescope was used to detect the ^{3}He particles. Angular distributions for the ^{3}He groups were compared with DWBA predictions to obtain angular momentum transfers and spectroscopic factors. States were observed corresponding to the removal of protons from the $1g_{9/2}$, $2d_{5/2}$, $2d_{3/2}$ and $3s_{1/2}$ shell-model orbits. In addition, states are populated which are due to pick-up of $1g_{9/2}$, $2p_{1/2}$ and $2p_{3/2}$ protons from the next (lower) shell. The Q-value of the ^{130}Te(d,^{3}He)^{129}Sb reaction was measured to be –4.55 ± 0.03 MeV; it significantly increases the accuracy of the measured mass for ^{129}Sb. (auth)

44690 EXCITED STATES OF ^{154}Gd. Ng, L. K.; Mann, K. C.; Walton, T. G. (Univ. of British Columbia, Vancouver). Nucl. Phys., A116: 433-51(1968).

The radiations emitted in the decay of ^{154}Eu to ^{154}Gd were examined with Ge(Li) and intermediate-image beta-ray spectrometers. The energies and intensities of the gamma rays, primary betas, and conversion electrons were measured; and two new branch decays from the 1396.9-keV level in ^{154}Gd were observed. Reduced transition probability ratios for both E0 and E2 transitions were deduced from the data together with electric monopole strengths. The results are compared with the predictions of the asymmetric rotator model of Davydov and Chaban and with the unified model of Bohr and Mottelson. (auth)

44691 THE DECAY PROPERTIES OF ^{206}Hg AND THE ^{208}Pb (p,3p)^{206}Hg REACTION. Wolf, G. K. (CERN, Geneva). Nucl. Phys., A116: 387-95(1968).

The ^{206}Hg nucleus was produced by the ^{208}Pb(p, 3p)^{206}Hg reaction, and its decay properties were investigated. The half-life was determined to 8.15 ± 0.1 min. Gamma, beta and conversion electron spectra were measured. It was found that the beta decay of ^{206}Hg leads to the ground state (59%), to a 305 keV state (36%) and to a 650 keV state (5%) of ^{206}Tl. The spins and parities assigned to these states are 0^-, 1^-, 1^-, respectively. No evidence of the low-lying state ($\leq$10 keV) of ^{206}Tl predicted by shell-model calculations was found. Cross-section measurements for the ^{208}Pb(p, 3p)^{206}Hg reaction with 590-MeV and 19-GeV protons gave values of 600 μb and 260 μb. (auth)

44692 THE GAMMA-RAY SPECTRUM OF ^{227}Th. Davidson, W. F.; Connor, R. D. (Univ. of Manitoba, Winnipeg, Can.). Nucl. Phys., A116: 342-62(1968).

Using sources purified by ion-exchange techniques, a study of the γ spectrum of ^{227}Th was undertaken using an argon-filled proportional counter, a high-resolution Ge(Li) spectrometer, and a hybrid NaI–Ge(Li) coincidence system. A total of 67 γ rays was observed, 25 of them for the first time; and their energies and absolute quantum intensities measured. Upper limits were placed on the intensities of eight γ rays reported previously but not observed here. A decay scheme involving 31 energy levels in ^{223}Ra is presented. (auth)

44693 MEAN KINETIC ENERGY OF FRAGMENTS AT THE FISSION OF ^{237}Np BY NEUTRONS. Kozlov, A. G.; Kuzminov, B. D.; Kutsaeva, L. S.; Sergachev, A. I. Yadern. Fiz., 7: 1185-6(June 1968). (In Russian).

The mean kinetic energy dependence of fragments was investigated in the fission of ^{237}Np by neutrons with energies of 0.42, 0.62, 1.0, and 1.3 MeV. Results show that the mean kinetic energy of fragments $\bar{E}_k$ in the fission of ^{237}Np by neutrons does not practically vary in the energy range under investigation. (auth)

44694 MEASUREMENT OF β^+-p COINCIDENCES FOR ^{111}Te EMITTER OF DELAYED PROTONS. Bacho, I.; Bogdanov, D. D.; Daroczy, S.; Karnaukhov, V. A.; Petrov, L. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 7: 1153-60 (June 1968). (In Russian).

Simultaneous measurements of the proton spectra were made with and without coincidences with positrons for ^{111}Te($T_{1/2}$ = 19.5 sec) in the reaction ^{102}Pd(^{12}C,3n)^{111}Te. These spectra are substantially different as the coincidences extract only the positron-decay branch for ^{111}Te. The ratio of the intensities for these spectra is determined by the ratio of probabilities of the positron decay and the K-electron capture for the transition of ^{111}Te into the proton-unstable state of ^{111}Sb. The measured ratios of the proton intensities are compared with the calculated energy function. The best agreement is obtained with $Q_o - B_p$ = 5.07 ± 0.07 MeV, where Q_o is the energy of the K-electron capture for ^{111}Te and B_p is the proton binding energy for ^{111}Sb. The value of $Q_o - B_p$ is in the best agreement with the calculations from the Zeldes and the Garvey–Kelson formulas. (auth)

44695 LOWER EXCITED STATES OF NUCLEUS ^{152}Eu. Borovikov, A. V.; Gvozdev, V. S.; Porsev, G. D. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 7: 1161-7(June 1968). (In Russian).

Coincidence spectra of conversion electrons from the reaction ^{151}Eu(n,γ)^{152}Eu induced by thermal neutrons were measured. The coincidences 89.9–109.4–46.1–40.6 keV and 77.26–73.4–46.1–40.6 keV were investigated. The scheme of the lower excited levels of ^{152}Eu is constructed. The different nature of the ground state and of the first excited state of the nucleus is established. (auth)

44696 A NOTE ON THE 222-keV GAMMA-RAY TRANSITION IN THE DECAY OF ^{133}Ba. Mangal, P. C.; Trehan, P. N. (Panjab Univ., Chandigarh, India). Indian J. Phys., 41: 938-40(Dec. 1967).

A high-efficiency sum-peak coincidence spectrometer was used to investigate the decay of ^{133}Ba. The existence of a 222-keV transition was confirmed, and the relative intensity of the transition was determined. (D.C.W.)

44697 MASS DISTRIBUTION STUDIES IN NUCLEAR FISSION USING LEXAN DETECTOR. Rangarajan, R.; Iyengar, K. N.; Hiranandani, M. R. (Tata Inst. of Fundamental Research, Bombay). Indian J. Phys., 41: 902-7(Dec. 1967).

An investigation of the ranges of fission fragments from thermal fission of ^{235}U was made using Lexan polycarbonate detector. A method of sandwiching the uranium between two layers of "Lexan" enabled a simultaneous measurement on the two fragments. The averaging ranges of the fragments of the light and heavy groups in Lexan were found to be 20.22 ± 0.027 microns and 16.38 ± 0.021 microns, respectively. It is found that from the correlated range measurements, the fragment masses can be estimated fairly accurately using an iteration procedure. (auth)

44698 TWICE-FORBIDDEN β^- TRANSITION ^{94}Nb → ^{94}Mo. Hocquenghem, J. C.; Berthier, J. (Faculte des Sciences, Grenoble, France. Centre d'Etudes Nucleaires, Grenoble, France). Nucl. Phys., A115: 661-72(1968). (In French).

The matrix elements of the twice-forbidden beta transition between the ground state of ^{94}Nb and the second excited state of ^{94}Mo were deduced from the experimental values of the shape factor and of the β-γ directional correlation. The same quantities were calculated assuming that the neutrons and the protons outside N = 50 and Z = 40 are in the $1g_{9/2}$ and $2d_{5/2}$ orbits, respectively, and that the effective nucleon-nucleon interactions are given by the experimental spectra of ^{92}Mo, ^{92}Zr, and ^{92}Nb. The relativistic matrix element was evaluated using the CVC theory with the approximation proposed by Damgaard and Winther. The radial matrix elements were computed with harmonic oscillator wave functions. The discrepancies found between the experimental and the theoretical values seem to be due essentially to the simplified shell-model radial wave functions and to the configuration chosen. (auth)

44699 E1 ELECTROMAGNETIC TRANSITIONS IN THE ODD NUCLEI ^{170}Lu, ^{172}Lu, AND ^{176}Ta. Abou-Leila, H. M. H. (Laboratoire Joliot-Curie, Orsay, France); Ceuleneer, R.; Vanhorenbeeck, J. Nucl. Phys., A115: 635-40(1968). (In French).

The experimental values of the E1 electromagnetic transitions between intrinsic levels in the odd deformed nuclei ^{170}Lu, ^{172}Lu, ^{176}Ta, and in the neighboring odd-mass nuclei ^{169}Yb, ^{171}Yb, ^{175}Hf are analyzed by means of the Nilsson model. The hypothesis that these transitions can be attributed to the same mechanism is discussed. (auth)

44700 ON THE DECAY OF ^{165}Dy. Bashandy, E.; Ibrahiem, N.; El-Sayad, G. (Atomic Energy Establishment, Cairo). Z. Naturforsch., 23a: 962-7(July 1968).

The internal conversion electron spectrum of transitions in the decay of 139-min ^{165}Dy to ^{165}Ho was studied using a high-resolution iron-free double-focusing β spectrometer. In addition to γ rays previously reported, eight new γ rays, mostly in the low-energy region, were observed. A decay scheme involving 17 excited levels is proposed for ^{165}Ho. Multipolarity data, obtained from the measurements of absolute or ratios of conversion coefficients of γ rays, were utilized for assigning possible spins and parities to the levels of ^{165}Ho. The experimental level structure is discussed in the light of nuclear models. (auth)

44701 CORE EXCITATION IN ^{193}Ir. Avida, R.; Burde, J.; Molchadzki, A. (Hebrew Univ., Jerusalem). Phys. Rev. Lett., 21: 441-4(Aug. 12, 1968).

The energy-level scheme of ^{193}Ir populated by the beta decay of ^{193}Os shows that the behavior of ^{193}Ir resembles that of ^{197}Au. The core-excitation model is tested by comparing theory with experimental transition probabilities and magnetic and quadrupole moments. Good agreement is obtained, indicating that the levels can be described with wave functions from the coupling of the $d_{3/2}$ proton to the core. (D.L.C.)

44702 APPLICATION OF STATISTICAL THEORY TO THE DE-EXCITATION OF Xe COMPOUND NUCLEI WITH HIGH ANGULAR MOMENTUM. Brun, C.; Gatty, B.; Lefort, M.; Tarrago, X. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys., A116: 177-95(1968). (In French).

Angular and energy distributions were established of protons, deuterons, and alpha particles produced in the bombardment of a natural silver target by 74-MeV nitrogen ions. The experimental results were compared with theoretical values deduced from the evaporation mechanism taking into account angular momentum effects (Ericson's theory). A new type of calculation, which is analytical and not based on Monte-Carlo methods, was performed for this purpose. It is shown from this calculation and also in relation to angular distributions observed that emission of alpha particles is more probable at the end of the evaporation chain than at its beginning. The cross section for the formation of the compound nucleus is also discussed. (auth)

44703 THE ENERGY OF THE E, G, H, AND I_a CONVERSION LINES OF THE ThB β SPECTRUM. Antony, M. (Univ. of Strasbourg). J. Phys., E, 1: 873-4(1968).

Values of the energies of the E, G, H, and I_a rays of Th B were obtained by use of a semicircular focusing magnetic spectrometer. (auth)

44704 MASS DISTRIBUTION IN 14.8-MeV NEUTRON-INDUCED FISSION OF ^{232}Th. Thein, M.; Rao, M. N.; Kuroda, P. K. (Univ. of Arkansas, Fayetteville). Contract AT(40-1)-3235. J. Inorg. Nucl. Chem., 30: 1145-50(June 1968). (ORO-3235-29).

The distribution of mass in the rare-earth region was studied by isolating radiochemically several fission products belonging to 13 mass chains. The absolute activities for these nuclides were determined by β^- and γ-counting, and the cumulative fission yields were determined relative to ^{99}Mo. Using these experimental data the right side slope in the heavy peak of the mass-yield curve for this fission process is clearly defined. Its significance with reference to the 14-MeV fission of ^{237}Np and ^{238}U is qualitatively discussed. (auth) (UK)

44705 THE 65-MeV HELIUM ION-INDUCED FISSION OF ^{207}Pb. Neuzil, E. F.; Apt, Kenneth (Western Washington State Coll., Bellingham). J. Inorg. Nucl. Chem., 30: 1151-4(June 1968).

The 65-MeV helium ion-induced fission of ^{207}Pb found is consistent with the trends found in previous work and fits well with data determined by other laboratories using different techniques. The fission-fragment mass distribution curve was Gaussian, with a width at half maximum ($W_{1/2}$) of 20 ± 1 amu. The cross section determined from the Gaussian distribution was 44.5 ± 5 mbarn. (auth) (UK)

44706 THE 41- AND 35-MeV HELIUM ION-INDUCED FISSION OF ^{185}Re AND ^{187}Re. Neuzil, E. F.; Assink, James E.; Apt, Kenneth (Western Washington State Coll., Bellingham). J. Inorg. Nucl. Chem., 30: 1161-7(June 1968).

Extension of the particle-induced fission of elements of atomic number less than 84 has produced a pattern for the characteristics of the observed symmetric fission fragment mass distribution curves. The enriched isotopes ^{185}Re and ^{187}Re were bombarded with 41- and 35-MeV helium ions and produced fission fragment curves which have widths at half maximum, $W_{1/2}$, of the order of 9 ± 2 amu for each species. The results are somewhat uncertain due to what appears to be a residual low level contamination in the Re powder targets. This yields a rather broad-based mass distribution curve out of which rises the apparent fission fragment distribution curve of the ^{185}Re and ^{187}Re. The determinations are further complicated by the fact that the total fission cross sections, σ_f, for these two species are of the order of 10 μbarn. The pseudo fission fragment cross sections for the suspected contamination are of the order of 0.01 μbarn or more. The total cross sections for fission of ^{185}Re and ^{187}Re were 12.7 and 9.6 μbarn, respectively at 41 MeV, and 5.1 and 5.8 μbarn, respectively, at 35 MeV, with an error of approximately ±20 per cent in all cases. (auth) (UK)

44707 THE DECAY OF ^{94}Ru. Boswell, G. G. J.; McGee, T. (Univ. of Salford, Eng.). J. Inorg. Nucl. Chem., 30: 1139-43 (June 1968).

The half-life of ^{94}Ru was accurately determined by milking the technetium daughter by a cyclohexanone extraction. The gamma spectrum was obtained using a lithium-drifted germanium detector. The half-life of ^{94}Ru was found to be 51.8 ± 0.6 min. (auth) (UK)

44708 DELAYED NEUTRON PRECURSORS. I. ANTIMONY AND ARSENIC PRECURSORS SEPARATED BY ELECTROLYSIS. Tomlinson, L.; Hurdus, M. H. (Atomic Energy Research Establishment, Harwell, Eng.). J. Inorg. Nucl. Chem., 30: 1125-38(June 1968).

Using an improved electrolytic separation technique, further studies are reported of delayed neutron emission from Sb and As fission product isotopes. Previous results were confirmed, and a difference in half-life between the two short-lived delayed neutron precursors was established. Least-squares fits of the data gave the following half-lives: ^{135}Sb, 1.59 ± 0.09 sec; ^{85,86}As, 2.03 ± 0.03 sec. In the thermal neutron fission of ^{235}U, the absolute delayed neutron yields of these nuclides (neutrons/10^4 fissions) are: ^{135}Sb, 3.6 ± 0.5, ^{85,86}As, 9.4 ± 1.3. The long-lived delayed neutron precursor detected previously ($t_{1/2}$ 14 ± 4 sec) was shown to be due to one of the elements Sb, As, Sn, Ge, Se, or Te, and not to halogen contamination. It appears to consist of two components, one with a half-life of 9 to 12 sec and the other much longer lived. (auth) (UK)

44709 1^-NEUTRON PARTICLE-HOLE STATES IN ^{208}Pb POPULATED BY PROTON DECAY OF ANALOG RESONANCES. Cramer, J. G.; von Brentano, P.; Phillips, G. W.; Ejiri, H.; Ferguson, S. M.; Braithwaite, W. J. (Univ. of Washington, Seattle). Phys. Rev. Lett., 21: 297-300(July 29, 1968).

Gamma rays from the decay of neutron particle-hole states in ^{208}Pb populated by analog resonances in ^{209}Bi were measured with a Ge(Li) crystal. Twelve states are found to have observable ground-state transitions. States at 5.27, 5.50, 5.94, 6.32, 6.49, and 7.09 MeV were assigned $J^\pi = 1^-$ on the basis of ground-state branching fractions and angular distributions. (auth)

44710 ONE-PARTICLE PROTON STATES OF THE RARE-EARTH NUCLEI. NEUTRON AND PROTON E1 TRANSITIONS. Chepurnov, V. A. Yadern. Fiz., 7: 1199-1209(June 1968). (In Russian).

One-particle proton states in the Woods-Saxon potential at $150 < A < 190$ are considered by means of the numerical integration of the boundary problem. The state structure and the amplitude radial dependence are compared with the results obtained by methods of diagonalization. One-particle neutron and proton E1 transitions are discussed. (auth)

44711 QUASISTABLE STATES OF FISSILE NUCLEI. Vorotnikov, P. E. Yadern. Fiz., 7: 1228-33(June 1968). (In Russian).

On the basis of the results of a channel analysis of the neutron fission of ^{230}Th and ^{234}U, it is shown that irregularities in the cross section and in the angular distributions of the fission fragments in the threshold domain are due to the quasistable states of the fissile nucleus. The height and the shape of the fission barrier are equal for the state of a compound nucleus with various values of internal nucleon momenta. Thus, for the compound nucleus ^{235}U, the barrier height for negative states is 6.09 ± 0.03 MeV. The curvatures of the fission barriers for ^{231}Th and ^{235}U are 950 ± 25 and 820 ± 25 keV, respectively. (auth)

44712 PREFERRED REACTIONS FOR THE FORMATION OF SUPERHEAVY NUCLEI. Kelson, I. (Yale Univ., New Haven). Phys. Lett., 27B: 261-3(Aug. 5, 1968).

The relative cross section for the formation of superheavy nuclei through fusion, as a function of the target-projectile pair, is investigated and a charge ratio of about 1.5 is shown to be generally preferred. (auth)

44713 TRANSITIONS IN ^{189}Os. Sychikov, G. I.; Kovrigin, O. D. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 7: 49-56 (1967). (In Russian).

A survey is made of the investigation of the radiation of the iridium isotope with mass 189, carried out on the double-focusing β spectrometer and a semiconductor γ spectrometer. New data on the comparative intensities in the daughter nucleus ^{189}Os made it possible to consider and make more precise the different variants of the decay scheme of ^{189}Ir. An analysis of the levels of ^{189}Os was made on the basis of the Bohr-Mottelson-Nilsson theory. The reduced probabilities for the magnetic dipoles and electric quadrupole transitions in this nucleus were calculated. Comparison with experimental data made more precise the nature of the excited levels of ^{189}Os and separated the single-particle levels from collective levels. (tr-auth)

44714 MEAN KINETIC ENERGY OF FRAGMENTS OF ^{235}U AND ^{238}U DURING NEUTRON FISSION WITH ENERGY $E_n = 5$ TO 9 MeV. Kuvatov, K. G.; Okolovich, V. N.; Pavlov, A. F. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 7: 26-32(1967). (In Russian).

By means of a double ionization chamber with a grid, the dependence of the mean kinetic energy of fragments of ^{235}U and ^{238}U on the excitation energy of the fissioning nucleus ($E_x = 11$ to 15 MeV) was investigated. The results obtained indicate that the Taylor hypothesis on the independence of $\overline{E}_k$ on $\overline{E}_n$ is achieved in the indicated interval of neutron energy. The equations used for the energy balance, developed for fission, were derived by comparison of the results of the measurement of $\overline{E}_k$ with the measurement of the mean number of prompt neutrons ν in the energy range studied for the excitation of fissioning nuclei. (tr-auth)

44715 OUTLOOK FOR THE SYNTHESIS OF NEW ISOTOPES AND ELEMENTS. Flerov, G. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Usp. Fiz. Nauk, 95: 25-33(May 1968). (In Russian).

About 1500 isotopes are known at present, including about 100 in the transuranium region; however, theoretical considerations indicate that 4000 to 5000 could exist. There are several methods for preparing new isotopes; in the United States underground nuclear explosions have been applied with good success to create heavy uranium isotopes from ^{238}U, yielding other elements by β decay. Another method, started simultaneously in the United States and the Soviet Union, makes use of accelerated heavy particles, such as carbon, oxygen, neon and argon; in this case, instead of successive captures, the target nucleus may capture a whole complex of neutrons at once. In another process, the fusion reaction is used to create neutron-depleted isotopes. The synthesis of transuranium elements is rendered difficult by the very low cross sections. The presence of special impurities, such as lead, in the targets prevented the successful completion of several earlier tests concerning the synthesis elements 102 and 103. (TTT)

44716 EXCITED LEVELS OF THE ^{237}Np NUCLEUS OBTAINED BY α RADIOACTIVITY OF ^{241}Am. Kamoun, Robert; ballini, Rene; Bergstrom-Rohlin, Solveig; Kuchly, Jean-Marie; Siffert, Paul (CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. A and B, 266: 1241-4(Apr. 29, 1968). (In France).

Some α-γ coincidence measurements reveal several excited levels of the nucleus ^{237}Np and permit one to propose the transitions that are responsible for the various γ rays with energies above 103 keV. (tr-auth)

44717 LOW-LYING LEVELS IN THE ODD-MASS ISOTOPES OF ANTIMONY. De Pinho, A. G. (Instituto de Fisica, Rio de Janeiro); Jeronymo, J. M. F.; Goldman, I. D. Nucl. Phys., A116: 408-32(1968).

The core-particle-coupling model in which the motion of an unpaired particle is coupled to an oscillating field is used to calculate the properties of the low-energy spectra of the odd-mass isotopes of antimony. This model, despite its simplicity, provides a reasonably correct description of many observed data, e.g., energy levels, spectroscopic factors, and transition rates. It was stipulated that the description of the regular trends observed in the seven isotopes ranging from A = 113 to A = 125 should be obtained with a minimum of free parameters. (auth)

44718 NUCLEAR LEVELS OF ^{168}Yb EXCITED BY THE DECAY OF LUTETIUM WITH A 7-MIN PERIOD. Charvet, Andre; Chery, Roland (Univ., Lyon). Compt. Rend., Ser. A and B, 266: 1625-7(June 24, 1968). (In French).

Gamma singles and coincidence spectra from the decay of ^{168}Lu were measured. A level scheme incorporating the 104 most intense gamma transitions observed was constructed for ^{168}Yb. (D.C.W.)

44719 SPECTRUM OF INTERNAL CONVERSION ELECTRONS EMITTED IN THE β DECAY OF ^{233}Th. Sebille, Claire (CNRS, Orsay, France). Compt. Rend., Ser. A and B, 267: 159-62(July 8, 1968). (In French).

A study of the electron spectrum emitted in the decay $^{233}\text{Th} \rightarrow {}^{233}\text{Pa}$ revealed 75 lines corresponding to 30 transitions, of which only 3 have previously been observed in internal conversion in this decay. (tr-auth)

44720 RADIOACTIVE DECAY OF ^{199}Au. Radhakrishna Murty, V. (Panjab Univ., Chandigarh, India); Jnanananda, Swami. Indian J. Pure Appl. Phys., 6: 223-5(May 1968).

The fractional intensities of crossover and cascade were obtained in the decay of ^{199}Au with the help of a 4π sum-peak coincidence spectrometer. The ratio of the transition probabilities $T(E_2)_{208}/T(M_1)_{50}$ obtained from the properties of the core excitation model is found to be in better agreement with the experimental value than the same value computed from the single-particle estimate. The relative gamma intensities are computed assuming the beta intensities. (auth)

44721 ISOMERIC CROSS-SECTION RATIOS FOR THE ^{107}Ag$(\alpha,2n)^{109g,m}$In AND ^{109}Ag$(\alpha,2n)^{111g,m}$In REACTIONS. Smend, F.; Weirauch, W.; Schmidt-Ott, W.-D. (Univ., Goettingen, Ger.). Z. Phys., 214: 437-46(1968). (In German).

Isomeric cross-section ratios were measured for the reactions ^{107}Ag$(\alpha,2n)^{109g,m}$In and ^{109}Ag$(\alpha,2n)^{111g,m}$In for α-particle energies between 19 and 40 MeV. The experimental isomeric cross-section ratios are compared with statistical-model calculations. The program of Hafner et al. was extended by including the competition of the (α,n) and $(\alpha,3n)$ reactions and of charged-particle emission. Agreement between experiment and theory could be achieved. (auth)

44722 DETERMINATION OF ANGULAR MOMENTS AND MULTIPOLE MIXTURES IN ^{211}Bi. Gorodetzky, S.; Beck, F. A.; Byrski, T.; Knipper, A. (Centre de Recherches Nucleaires, Strasbourg). Nucl. Phys., A117: 208-30(1968). (In French).

The ^{211}Bi gamma spectrum resulting from the decay of ^{211}Pb was measured with Ge(Li) detectors directly and in coincidence with a scintillation counter. Internal conversion measurements and angular correlations and direction-polarization correlations in the cascades 704 − 405 keV and 427 − 405 keV have fixed the spins and parities of the 1109-, 832-, and 405-keV levels as $9/2^-$, $5/2^-$, and $7/2^-$. The mixing ratios were determined to be $\delta(704\ \text{keV}) = 0.127 \pm 0.075$, $\delta(427\ \text{keV}) = 0.166 \pm 0.149$, and $\delta(405\ \text{keV}) = -1.15 \pm 0.19$. (auth)

44723 STUDY OF THE DECAY ^{155}Sm$(\beta^-)^{155}$Eu. Widemann, F.; Sebille, C. (CNRS, Orsay, France). Nucl. Phys., A117: 129-42(1968). (In French).

The conversion electron spectrum of ^{155}Sm was investigated with a semicircular spectrometer. The gamma-ray spectrum was studied with a Ge(Li) detector (FWHM = 1.7 keV at 100 keV). 60 new lines were found in the electron spectrum; ten new transitions were identified in the gamma-ray spectrum. A modified level scheme of ^{155}Eu is proposed. The $1/2^+(411)$ rotational band is found. The decoupling parameter has an anomalous value. (auth)

44724 SHELL-MODEL STUDY OF THE ELASTIC PROTON DECAY WIDTHS OF THE ^{89}Y AND ^{91}Nb ANALOG STATES. Beres, William P.; Divadeenam, M. (Duke Univ., Durham, N. C.). Nucl. Phys., A117: 143-60(1968).

The elastic proton escape width $\Gamma\uparrow$ and the damping width $\Gamma\downarrow$ of the $1/2^+$, $3/2^+$, and $5/2^+$ analog levels in ^{89}Y and ^{91}Nb are calculated on a basis of one-particle, 2p-1h and 3p-2h states. In particular, a two-body delta function residual interaction is employed in a 2p-1h basis to produce the levels at the observed experimental energies. The same interaction strength is then used to obtain the widths. The Coulomb interaction is taken into account by using neutron and proton wave functions with different radial forms. The damping widths are obtained using a Lorentz distribution and a box distribution. The latter gives somewhat smaller damping widths, but when added to the proton escape widths, both weighting functions produce total widths that are in very good agreement with the corresponding experimental values. This lends support to the doorway interpretation of intermediate structure. The results for the two nuclei are compared. (auth)

44725 TABLE OF SPECIFIC ACTIVITIES OF THE NUCLIDES WITH Z = 88 TO Z = 194. Schirmer, W.; Waechter, N. (EURATOM, Karlsruhe, Ger.). Actinides Rev., 1: 125-34(June 1968).

The specific activities of all the nuclides of the elements from Ra through Ku were calculated on the basis of the decay data published by A. H. Wapstra (Actinides Reviews, 1: 39-53(1967)). Data for short-lived nuclides are included mainly in view of their genetic relation with longer-lived nuclides. (D.C.W.)

44726 DIRECTIONAL CORRELATIONS IN THE DECAY OF ^{148}Pm. Wyly, L. D.; Patronis, E. T.; Braden, C. H. (Georgia Inst. of Tech., Atlanta). Phys. Rev., 172: 1153-9(Aug. 20, 1968).

The directional correlation between the 1930-keV β group and the 551-keV γ in the decay of 5-day ^{148}Pm was measured. The anisotropy is found to be only a few percent over the β energy range from 1050 to 1800 keV. Directional correlations for the following γ-γ cascades in the decay of 41-day ^{148}Pm were measured: 414 – 630 keV, $A_2 = -0.07 \pm 0.03$; 414 – 551 keV, $A_2 = 0.04 \pm 0.03$; 288 – 630 keV, $A_2 = 0.17 \pm 0.02$; and 288 – 551 keV, $A_2 = 0.19 \pm 0.02$. A note on simple properties of directional correlations involving unobserved γ rays which hold in special cases is appended. (auth)

44727 DECAY OF ^{136}La AND ^{134}La. Julian, Glenn, M.; Fessler, Theodore E. (Lewis Research Center, Cleveland). Phys. Rev., 172: 1208-13(Aug. 20, 1968).

Sources of 9.87-min ^{136}La and 6.82-min ^{134}La were made by the (p,n) reaction on enriched ^{136}Ba and ^{134}Ba. A 20-cc Ge(Li) detector was used to observe the γ rays emitted by these sources. The energies in keV (with relative intensities in parentheses) of γ rays emitted in the decay of ^{136}La are 760.4(14.3), 818.5(100), 1019.1(5.6), 1261.7(1.3), 1310.5(4.5), 1322.5(13.0), 1497.1(2.1), 2127.7(1.7), and annihilation radiation (3090). The energies in keV (with relative intensities in parentheses) of γ rays emitted in the decay of ^{134}La are 563.5(6.7), 604.7(100), 1168.9(2.6), 1211.0 (2.4), 1321.1(2.4), 1424.1(3.9), 1482.4(2.3), 1555.0(8.6), 1731.7(4.9), 1960.4(2.0), 1995.2(1.4), 2088.6(0.8), and annihilation radiation (2200). These results are consistent with the existence of excited states of ^{136}Ba at 818.5, 1578.9, 2080.2, 2128.5, 2141.0, and 2315.6 keV, and excited states of ^{134}Ba at 604.7, 1168.2, 2159.7, 2336.4, 2489.3, 2565.1, 2599.9 and 2693.3 keV. (auth)

44728 BETA DECAY OF ^{146}Ce. Hoffman, D. C.; Lawrence, F. O.; Daniels, W. R. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. Phys. Rev., 172: 1239-43(Aug. 20, 1968). (LA-DC–9458).

The γ-ray spectrum of 14-min ^{146}Ce was reexamined with a high-resolution Ge(Li) detector, and the following previously unreported γ transitions were observed: 106.4, 351.9, 369.1, 415.6, 467.9, 491, and 503.0 keV. A previously observed peak at ≈99 keV was resolved into 98.3- and 100.9-keV photopeaks. More precise energies and additional conversion coefficients were determined for many of the transitions. On the basis of energy differences a new level, believed to be 1^+, was placed at 503.0 keV. γ–x-ray and γ–electron coincidence measurements suggest that a previously postulated 35-keV level is de-excited by a 23 – 12-keV γ cascade. (auth)

44729 DEFORMATION IN THE LIGHT Ba ISOTOPES: ISOMERIC STATES OF ^{125}Ba AND ^{127}Ba. D'Auria, J. M. (Yale Univ., New Haven); Bakhru, H.; Preiss, I. L. Contract AT(30-1)-2726. Phys. Rev., 172: 1176-86(Aug. 20, 1968). (YALE-2726-H-97).

The existence of isomeric states and the relative spacing of these levels, in the light barium isotopes associated with the population of $h_{11/2}$ and $s_{1/2}$ or $d_{3/2}$ states, could be an aid in establishing both the sign and the extent of the nuclear deformation, if interpreted in the spirit of the Nilsson levels or the approach of Kumar and Baranger. Isomerism was observed in the cases of ^{125}Ba and ^{127}Ba, with the unique characteristic that the high-spin states lie below the low-spin states of the isomeric pair. These isomers were formed using heavy-ion reactions for direct formation of the high-spin states and from β decay of their parents for the low-spin states. ^{125}Ba decays from the high-spin state ($T_{1/2} = 3.0 \pm 0.5$ min) by β^+ ($E_{ww} = 4.6$ MeV) to levels at ~20, 76, and 160 keV, while the low-spin state ($T_{1/2} = 8 \pm 1$ min, $E_{ww} = 5.5$ MeV) decays principally to the ground state and a state at <30 keV. ^{127}Ba, in turn, gives rise to γ rays of 70, 110, 180, and 200 keV, with the high-spin state ($T_{1/2} = 18$ min) separated from the low-spin state ($T_{1/2} = 10 \pm 1$ min) by 200 keV. This inversion of the Nilsson states from ^{129}Ba would indicate that the deformation is oblate (negative β) and has a value of between 0.11, the point where $h_{11/2}$ crosses $d_{3/2}$-$s_{1/2}$, and ~0.2, where the onset of a $7/2^-$ state would present an E3 transition between isomers of short half-life. (auth)

44730 THREE-QUASIPARTICLE INTRUDER STATE IN ^{125}Te AND THE MAGNETIC MOMENT OF ^{125}Sb. Stone, N. J.; Frankel, R. B.; Shirley, D. A. (Univ. of California, Berkeley). Contract W-7405-Eng-48. Phys. Rev., 172: 1243-52(Aug. 20, 1968). (UCRL–18000).

The levels of ^{125}Te were studied using ^{125}Sb nuclei, polarized at T = 0.014°K in an iron lattice, and Ge(Li) detectors. The magnetic moment of ^{125}Sb was determined to be $2.59 \pm 0.03\ \mu_N$. Levels (spins) were assigned at 35.9 ($3/2^+$), 145.4 ($11/2^-$), 322.2 ($9/2^-$), 443.7 (probably $3/2^+$), 462.5 ($5/2^+$), 525.4 (probably $9/2^-$), 636.1 ($7/2^+$), 642.3 ($7/2^+$), 671.6 ($5/2^+$) (energies in keV). The even-parity levels could be identified with levels calculated by Kisslinger and Sorensen. Using their wave functions, E2/M1 mixing ratios and branching ratios were calculated finding quite good agreement. The odd-parity states are of special interest. The $11/2^-$ 145.4-keV state and $9/2^-$ 525.4-keV state are assigned a $h_{11/2}$ quasiparticle and $h_{11/2}$ quasiparticle plus phonon. The $9/2^-$ state at 322.2 keV is not predictable on a single-quasiparticle-plus-phonon theory, and is assigned as a three-quasiparticle $(h_{11/2})^3$ intruder state, bearing out Kisslinger's prediction that $(j^3)_{j-1}$ intruder states should be found in low-lying spectra for high j. Evidence for other intruder states in ^{100}Rh, ^{109}Ag, and ^{110}Ag is given. (auth)

44731 LEVELS IN ^{133}I FROM THE DECAY OF ^{133m}Te AND ^{133g}Te. McIsaac, L. D. (Idaho Nuclear Corp., Idaho Falls). Phys. Rev., 172: 1253-61(Aug. 20, 1968).

The level structure of ^{133}I excited in the β decay of 54-min ^{133m}Te and 12-min ^{133g}Te was studied using Ge(Li) γ-ray spectrometers in conjunction with a 4096-channel pulse-height analyzer. Coincidence measurements were carried out using two NaI(Tl) spectrometers and a 256 × 256-channel coincidence analyzer. Sources of ^{133g}Te were made, free of ^{133m}Te, by an isomeric separation method. All 14 transitions associated with the decay of ^{133g}Te were placed in a consistent decay scheme on the basis of the coincidence measurements, relative intensities, and energy combinations. Levels in ^{133}I populated from ^{133g}Te occur at 311.99, 719.65, 786.77, 1312.8, 1333.23, 1564.1, 1717.65, and 2193.5 keV. From a β endpoint measurement using an anthracene detector, a total disintegration energy for ^{133g}Te of 2.96 MeV was obtained. Log ft values and β branching ratios were calculated from the γ-ray intensities. The decay scheme of ^{133m}Te is quite complex, with 63 additional γ rays having been identified with this activity. Of these, only three have been unambiguously placed in the decay scheme. They require the existence of additional levels in ^{133}I at 912.58, 1560.0, and 1776.5 keV. (auth)

44732 NEUTRON HOLE STATES IN Z = 40 NUCLEI STUDIED WITH THE (p,d) REACTION ON ^{90}Zr, ^{91}Zr, AND ^{92}Zr. Ball, J. B.; Fulmer, C. B. (Oak Ridge National Lab., Tenn.). Phys. Rev., 172: 1199-1207(Aug. 20, 1968).

The (p,d) reaction on ^{90}Zr, ^{91}Zr, and ^{92}Zr was studied at a proton energy of 31 MeV. Deuteron spectra were measured with a broad-range magnetic spectrograph. The reaction on ^{90}Zr excites strongly the ground state of ^{89}Zr (l = 4) and excited states at 0.588 MeV (l = 1), 1.094 MeV (l = 1), and 1.450 MeV (l = 3). These states are shown to be consistent with pickup of neutrons from the $1g_{9/2}$, $2p_{1/2}$, $2p_{3/2}$, and $1f_{5/2}$ shell-model levels, respectively. On this basis definite spin-parity assignments are made to these levels. Small portions of the strength for pickup of these neutrons are also observed for higher excited states. The reaction on ^{91}Zr excites the states corresponding to the creation of the $1g_{9/2}$ hole and the consequent coupling of this hole to a $2d_{5/2}$ neutron. All six of the expected one-particle one-hole states are observed. The ^{92}Zr target, which was included to study the effect of this isotopic impurity in the ^{91}Zr target, yielded data on a number of excited states in ^{91}Zr. (auth)

44733 THERMAL-NEUTRON FISSION OF ^{235}U: IDENTIFICATION AND FRACTIONAL CHAIN YIELD OF 17-SEC ^{77}Ga. Wish, L. (Naval Radiological Defense Lab., San Francisco). Phys. Rev., 172: 1262-66(Aug. 20, 1968).

The study of nuclear charge dispersion in the light-fission-product region from thermal-neutron irradiation of ^{235}U was begun with measurements on mass chain 77. An ion exchange procedure was developed which rapidly separated Ga from its daughter products, Ge and As. Ga separations were made at various times after fission, and the Ge daughter activities were isolated and measured. From these activities ^{77}Ga and ^{78}Ga were indirectly identified as fission products. The half-life of ^{77}Ga was determined to be 17.1 ± 1.5 sec, and that of ^{78}Ga was estimated to be about 4 sec. The branching ratio of ^{77}Ga for formation of ^{77m}Ge and ^{77g}Ge was obtained from measurements of the 39-h ^{77}As activity at the time when the 54-sec ^{77m}Ge and the 11.3-hr ^{77g}Ge had each mostly decayed. Values obtained for decay to ^{77m}Ge and ^{77g}Ge are 0.88 ± 0.02 and 0.12 ± 0.02, respectively. The fractional cumulative yield of ^{77}Ga was determined as 0.573 ± 0.014. (auth)

44734 FISSION-FRAGMENT MASS AND CHARGE DISTRIBUTION FOR THE MODERATELY EXCITED ^{236}U COMPOUND NUCLEUS. McHugh, J. A.; Michel, M. C. (Univ. of California, Berkeley). Phys. Rev., 172: 1160-75(Aug. 20, 1968).

The helium ion-induced fission of ^{232}Th (^{236*}U) was investigated by using high-sensitivity mass-spectrometric techniques. The relative cumulative yields for the majority of isotopes in the mass ranges 83 to 90 and 131 to 153 were measured. The xenon cumulative yields show no structure at these excitations (20 to 57 MeV).

The independent yields of 15 isotopes produced in the fission of ^{236*}U were measured for various excitation energies ranging from 20 to 57 MeV. In addition, a number of independent and cumulative yields have been measured for the helium ion-induced fission of ^{235}U. The nuclear charge distribution function was measured directly for one isobaric sequence and indirectly in another; the distribution was found to be Gaussian $y_i \propto \exp[-(Z - Z_p)^2/0.95]$, and independent of the excitation in ^{236*}U (to 39 MeV). The empirical Z_p function obtained from the measured independent yields shows none of the trends observed for low-excitation fission of ^{236*}U in the 82-neutron-shell region. The total number of neutrons emitted per fission as a function of mass ratio of the fragments was derived from the Z_p function; the neutron yields were found to depend strongly on the asymmetry of the fission mode. Fragment neutron yields were derived from an analysis of the empirical Z_p function and the theoretically predicted Z_p function. (auth)

44735 IDENTIFICATION OF 5.3-SEC ^{118}Ag AS A PRODUCT OF ^{235}U FISSION. Weiss, H. V.; Fresco, J. M.; Reichert, W. L. (Naval Radiological Defense Lab., San Francisco). Phys. Rev., 172: 1266-9(Aug. 20, 1968).

A search for ^{118}Ag was carried out as part of a study on the distribution of nuclear charge in symmetric fission. A method was developed for the separation of silver from its palladium precursor and cadmium descendant, based upon the rapid reduction and retention of silver by finely divided copper. Silver was separated at various times after thermal-neutron fission of ^{235}U. The copper powder with affixed silver was dissolved in concentrated nitric acid and radiochemically purified for the analysis of ^{118}Cd derived from its silver precursor. The linear relation between the logarithm of ^{118}Cd activity and separation time led to the identification of ^{118}Ag. The half-life of this radionuclide was determined to be 5.3 sec. (auth)

44736 IDENTIFICATION AND YIELD OF 5.0-SEC ^{117}Pd IN THE THERMAL-NEUTRON FISSION OF ^{235}U. Weiss, H. V.; Elzie, J. L.; Fresco, J. M. (Naval Radiological Defense Lab., San Francisco). Phys. Rev., 172: 1269-71(Aug. 20, 1968).

As part of a study of nuclear charge distribution in the region of symmetric fission, evidence for the existence and cumulative fission yield of ^{117}Pd was sought. Palladium was isolated free from silver and cadmium at different times after fission, and the quantity of descendant ^{117}Cd activity produced was measured. A half-life for ^{117}Pd of 5.0 sec was derived from these data. Through a comparison of ^{117}Cd activity produced by ^{117}Pd with the total ^{117}Cd activity produced by all isobars, a cumulative fractional chain yield of 0.669 was computed for ^{117}Pd. From this yield the most probable nuclear charge Z_p for the 117-mass chain was estimated. (auth)

44737 LIGHT NUCLEI EMITTED IN THE FISSION OF ^{252}Cf. Raisbeck, G. M.; Thomas, T. D. (Princeton Univ., N. J.). Phys. Rev., 172: 1272-82(Aug. 20, 1968).

Energy spectra and angular distributions were measured for ^{1}H, ^{2}H, ^{3}H, ^{4}He, ^{6}He, ^{8}He, Li, and Be ions emitted in coincidence with the spontaneous fission of ^{252}Cf. The data show that, with the possible exception of ^{1}H, all of the particles are strongly peaked at 90° with respect to the major fragments, and are probably released by a common mechanism. Using a point-charge model, with various combinations of starting conditions, trajectory calculations were made for each type of particle. It was found that reasonable agreement with the measured results could be obtained by using a consistent set of initial conditions: namely, a release time of 0.4×10^{-21} sec, corresponding to a separation distance of 21.5×10^{-13} cm for the major fragments, and an average initial energy of 2 MeV for the third particle. Both the angular distribution and the energy spectra of the ^{1}H particles appear to be somewhat anomalous in comparison with the calculations, and several possible reasons for this are discussed. For the first time, isotopes of boron and carbon from the fission of ^{252}Cf were observed; limits on the energy and yield of heavier particles are given. (auth)

44738 FISSION ENERGETICS AND NEUTRON EMISSION IN 13-MeV PROTON-INDUCED FISSION OF ^{226}Ra. Konecny, E.; Schmitt, H. W. (Oak Ridge National Lab., Tenn.). Phys. Rev., 172: 1213-26(Aug. 20, 1968).

The energetics of the fission of ^{226}Ra induced by 13-MeV protons were studied by means of a three-parameter experiment in which the time of flight of one fragment was measured in coincidence with the pulse amplitudes produced by both fragments in silicon surface-barrier detectors. The average number of neutrons emitted from individual fragments and from both fragments together are obtained as functions of fragment mass and total kinetic energy. In addition, the pre- and post-neutron-emission fragment mass distributions are obtained, together with the fragment energy distributions and mass-versus-energy correlations. Fragment excitation energies are inferred from the neutron-emission data, and the total energy balance is investigated. The experimental results suggest the presence of two components in ^{226}Ra + p fission, one a liquid-drop component describing events in the symmetric peak of the mass distribution, the other a fragment-structure component describing events in the asymmetric peaks. The various distributions and correlations obtained, including those involving neutron emission, were analyzed from this point of view and are seen to be quantitatively consistent with the assumption of two such components. It remains unclear, however, whether one or two saddle points are involved. (auth)

44739 ASYMMETRY, ANISOTROPY, AND EXCITATION FUNCTION FOR THE PROTON-INDUCED FISSION OF ^{226}Ra. Konecny, E.; Schmitt, H. W. (Oak Ridge National Lab., Tenn.). Phys. Rev., 172: 1226-31(Aug. 20, 1968).

The anisotropy of the fragment angular distribution, the asymmetry of the fragment mass distribution, and the relative cross section for proton-induced radium fission were measured as functions of incident proton energy in the range $6.0 \leq E_p \leq 13.0$ MeV. The anisotropy and excitation function were also studied as functions of E_p for the symmetric and asymmetric components of the mass distribution. The angular-distribution data for the two components of the mass distribution are similar. There is no conclusive evidence in these data to indicate whether one or two saddle-point states are involved in Ra + p fission. (auth)

44740 ANALYSIS OF EXCITATION FUNCTIONS IN Cm(C,xn)No REACTIONS. Sikkeland, Torbjorn; Ghiorso, Albert; Nurmia, Matti J. (Univ. of California, Berkeley). Phys. Rev., 172: 1232-38(Aug. 20, 1968).

Excitation functions for the synthesis of ^{251}No, ^{252}No, ^{253}No, ^{254}No, ^{255}No, ^{256}No, and ^{257}No in the bombardments of ^{244}Cm, ^{246}Cm; and ^{248}Cm with ^{12}C and ^{13}C are presented. A good fit to these functions was obtained by the use of the Jackson formula as modified to include fission and angular-momentum effects. Experimental values of $\langle\Gamma_n/\Gamma_f\rangle_{av}$ are compared with the semiempirical formula of Fujimoto and Yamaguchi and the following new empirical formula: $\log_{10}(\Gamma_n/\Gamma_f) = -0.276Z + f(N)$, where $f(N)$ is $5.46 + 0.140N$ for $N \leqq 153$ and $19.23 + 0.050N$ for $N \leqq 153$. A brief discussion of Γ_n/Γ_f systematics of transberkelium nuclides and the effect of the 152-neutron subshell is given. (auth)

44741 TERNARY FISSION OF ^{238}U INDUCED BY INTERMEDIATE-ENERGY HELIUM IONS. Iyer, R. H.; Cobble, J. W. (Purdue Univ., Lafayette, Ind.). Phys. Rev., 172: 1186-93 (Aug. 20, 1968).

Evidence is presented for the existence of ternary fission of a heavy excited nucleus into three fragments of comparable size from radiochemical studies on ^{238}U bombarded with 20 to 120-MeV helium ions. The absolute formation cross sections for ^{24}Na, ^{28}Mg, ^{31}Si, ^{38}S, ^{47}Ca, ^{56}Mn, and ^{66}Ni in the 39 ± 1 MeV ^{4}He-induced fission of ^{238}U clearly establish the transition region between binary and ternary processes, the crossover occurring around A = 47. The corresponding data for ^{183}Ta and ^{184}Ta and upper limits for ^{199}Au, ^{203}Pb, and ^{212}Pb also indicate the absence of any possible complementary heavy fragments. The fission-product nature of the light ternary fragments was confirmed by the forward-to-backward recoil properties. The excitation function for the formation of ^{28}Mg and the ratio $\sigma_{^{28}Mg}/\sigma_{total}$ drop very rapidly below an excitation energy of 20 MeV, making it highly unlikely that such light fragments can be observed at lower excitation energies. These conclusions are consistent with the previously reported lack of radiochemical evidence for the possible thermal neutron-induced ternary fission of ^{235}U, but are inconsistent with the claims to the contrary based on purely instrumental measurements. The mass-yield curve appears to be smooth in both the ternary and low-mass binary regions, and gives no indication of any "fine structure" in the ternary region. The recoil properties of ^{28}Mg and ^{89}Sr studies in the 40 to 120-MeV energy range indicate close similarities. A mean recoil range of 12.2 ± 0.4 mg/cm^2 in uranium was obtained for ^{28}Mg, corresponding to an average kinetic energy of 45 to 50 MeV based on similar heavy-ion range-energy data. (auth)

44742 FISSION OF IRIDIUM AT INTERMEDIATE EXCITATION ENERGIES. Brodzinski, R. L.; Cobble, J. W. (Purdue Univ., Lafayette, Ind.). Contract AT(11-1)-1716. Phys. Rev., 172: 1194-8(Aug. 20, 1968). (COO-1716-2).

Cross sections were determined radiochemically for 11 nuclides resulting from the fission induced in natural iridium (^{191,193}Ir) by 42.2-MeV ^{4}He ions. The mass distribution was found to be symmetric with a full width at half-maximum of 23 ± 2 mass units. The average number of prompt neutrons emitted per fission event was 2 ± 1, and the total fission cross section was found to be 45 ± 11 μb. Total fission cross sections were determined at 13 different energies by a plastic-track technique. Analysis of the Γ_f/Γ_n ratio, which is a measure of the competition between fission and neutron emission, indicates the fission threshold to be 22.3 ± 0.7 MeV and the fission level-density parameter to be $a_f = A/10$. These results are compared with similar data from the fission of other nuclei. (auth)

44743 EFFECT OF PHYSICAL STATE ON THE DECAY OF ^{131}I. Kemeny, P. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 13: 485-8(1968).

The effect of the chemical state of ^{131}I sources on the half-life of ^{131}I was investigated using liquid and solid sources. A comparative method of measurement was used, providing high accuracy. A difference of 4.3 ± 2.1% between the values obtained with liquid and solid sources was observed. (D.C.W.)

44744 ANGULAR DISTRIBUTION OF TRANSMITTED ELECTRONS WITH INCIDENT ENERGIES 3.2 TO 14.1 MeV. I. Tabata, Tatsuo; Ito, Rinsuke; Okabe, Shigeru. Annu. Rep. Radiat. Center Osaka Prefect., 8: 60-5(1967).

Angular distributions of transmitted electrons were measured for monoenergetic electrons of energies from 3.2 to 14.1 MeV normally incident on thick targets of Al, Cu, Ag, and Au. The thickness of the target used ranged from 8 to 80% of the practical range R of incident electrons in each element. The half-value angles of angular distributions observed were compared with Molière's multiple-scattering theory including energy-loss correction, and agreement was found for thicknesses less than about 0.15R in most cases. A simple modification of Molière's theory was made to explain the trend of the experimental result in the region of target thickness where it fails to hold. (auth)

44745 EXPERIMENTAL DETERMINATION OF THE RESONANCE INTEGRAL OF SILVER. Markovic, Velimir; Kocic, Antanasije. Bull. Boris Kidric Inst., Nucl. Sci., Nucl. Eng., 18: No. 2, 11-15(Nov. 1967).

The integral absorption cross section for various concentrations of silver was measured using the pile oscillator technique. The infinite dilution resonance integral was determined by measuring the calibration factor, the reactor spectral index, and the effective cross section of silver. The obtained value, 760 ± 20 barns, is in good agreement with the theoretical values reported. (auth)

44746 STUDY OF γ SPECTRA EMITTED BY ^{223}Ra AND ITS DERIVATIVES. Briancon, Chantal; Leang, Chin Fan; Walen, Robert (CNRS, Orsay, France). Compt. Rend., Ser. A and B, 266: 1533-6(June 17, 1968). (In French).

The γ spectra emitted in the decays $^{223}\text{Ra} \rightarrow {}^{219}\text{Rn} \rightarrow {}^{215}\text{Po} \rightarrow {}^{211}\text{Pb} \rightarrow {}^{211}\text{Bi} \rightarrow {}^{207}\text{Tl} \rightarrow {}^{207}\text{Pb}$ were studied using Ge(Li) junctions. The energies and intensities of the various γ rays and the assignments of the γ rays to nuclear level schemes are given. (D.C.W.)

44747 CONVERSION ELECTRON–GAMMA DIRECTIONAL CORRELATION MEASUREMENTS ON ^{192}Pt. Kukoc, A. H.; Marinkov, L. G.; Krmpotic, D. M.; Vukanovic, R. B. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Bull. Boris Kidric Inst. Nucl. Sci., Phys., 18: No. 2, 9-21(Oct. 1967).

Electron-gamma directional correlation measurements have been performed in cascades involving 604-, 308-, and 296-keV transitions in ^{192}Pt. The mixing ratios in the transitions were determined, and an E0 component was found in the 296-keV transition. These measurements unambiguously confirmed the spin of the 1200-kV level to be 4^+. (auth)

44748 DECAY SCHEME OF ^{188}Pt, Q-VALUE, AND K-ELECTRON-CAPTURE FRACTIONS P_K. Hanson, R. J.; Hansen, P. G.; Nielsen, H. L.; Soerensen, G. (Univ. of Aarhus, Denmark). Nucl. Phys., A115: 641-50(1968).

The electron-capture decay of 10.2-day ^{188}Pt was investigated with Ge(Li), Si(Li) and NaI(Tl) detectors, a six-gap magnetic spectrometer and coincidence techniques. Energies (in keV) and intensities (in %) of the gamma rays are K x-rays (100), 41.9(0.4), 54.8(0.3), 96.7(0.2), 98.4(0.4), 132.8(0.30), 140.3(2.2), 187.6(19.2), 195.1(18.4), 280.4(0.2), 283.0(0.11), 290.6(0.11), 381.6(7.0), 423.6 (4.4) and 478.3(1.9). The new gamma rays of 132.8, 283.0 and 290.6 keV resolve an ambiguity in the level scheme; a version involving a 7.5-keV first excited level can now be excluded. A K x-γ coincidence experiment shows that less than 1% of the electron capture to the 478.3 keV level proceeds by K-capture; consequently the Q_{EC} value of the ground-state decay is less than 558 keV. A lower limit on Q_{EC} of 519 keV was estimated. The K-to-total-capture ratio P_K was measured to be 0.766 ± 0.023 and 0.744 ± 0.020 for the first-forbidden decay to the 187.6- and 195.1-keV levels. (auth)

Nuclear Theory

Refer also to abstracts 44283, 44289, 44370, 44395, 44588, 44603–44605, 44609, 44610, 44612, 44620, 44639–44641, 44644, 44647, 44648, 44655, 44675, 44698, 44699, 44701, 44702, 44710–44712, and 44717.

44749 (IFA-FT-69) ON THE QUADRUPOLE–OCTUPOLE ANHARMONICITY IN THE VIBRATIONAL MOTION OF EVEN-EVEN SPHERICAL NUCLEI. Raduta, A. A.; Sandulescu, A.; Stratan, G. (Academia R. P. R., Bucharest. Institutul de Fizica Atomica). 1968. 28p. Dep.

A new method for treating the double quadrupole–octupole phonon states is given in which only the anharmonic terms which arise from the commutation of quadrupole and octupole operators are retained in the equations of motion. This gives nonlinear equations of motion, consequently modifying the quintet shift and the electromagnetic transaction. (J.W.R.)

44750 (ITEF-564) COEFFICIENTS OF ANGULAR CORRELATIONS OF DIPOLE AND QUADRUPOLE γ TRANSITIONS OF NUCLEI. Lobov, G. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1967. 12p. (In Russian). Dep.

Simple analytical expressions for the coefficients of various angular correlations in case of dipole and quadrupole γ transitions in nuclei, with arbitrary spins of nuclear states, are derived. Some properties of the Clebsch–Gordan, Fano and Racah coefficients are used. With the analytical expressions obtained for the coefficients, one can calculate angular correlations in a more simple way; and there is no necessity to use numerical tables for these coefficients. (auth)

44751 (JINR-E4-3837) EXACTLY SOLUBLE MODEL FOR RESONANCE SCATTERING. Lovash, I.; Revai, Ya. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 22p. Dep.

A model system is constructed consisting of a single particle potential and two interacting particles. The potential has two bound states thus for the two particle system four configurations exist. One of them lies in the continuum giving rise to a resonance of "compound" type. Both the potential and the two particle interaction are of nonlocal and separable types. The exact transition amplitudes are obtained by means of Faddeev's method. The model is designed for checking the "microscopic" nuclear reaction theories. (auth)

44752 (JINR-E4-3927) PRELIMINARY CALCULATIONS OF THE GROUND STATE CHARACTERISTICS OF ^{4}He NUCLEUS. Blank, J.; Ulehla, I.; Kukhtina, I. N. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1968. 22p. Dep.

Some results of the calculation of the binding energy, mean-square radius, charge distribution, and form factor of the ^{4}He nucleus are presented. The Goldstone perturbation theory is applied up to the second order in the energy and first order in the wave function. The Hamada–Johnston potential is used. (auth)

44753 (NP-17557) MODEL CALCULATION OF COULOMB EFFECTS IN THE THREE-NUCLEON SYSTEM. Alessandrini, Victor A.; Fanchiotti, Huner; Garcia, Carlos A. (La Plata Universidad Nacional (Argentina)). [1967]. 40p. Dep.

When two particles interact via a potential V which is the sum of a separable potential V_s and a Coulomb potential V_c, the two-body T-matrix can be obtained exactly and can be split in the usual way in a pure Coulomb T-matrix and a "nuclear" T-matrix which also contains Coulomb effects. Using the fact that the "nuclear" T-matrix is still separable in the off-shell variables, the Faddeev–Lovelace equations are applied to the calculation of Coulomb effects in the three-nucleon system, when the nuclear forces are described by separable interactions. The contribution of the non-separable Coulomb T-matrix to the potentials that appear in the Faddeev–Lovelace equations is neglected, although it is known how to introduce it in a perturbative fashion. The Coulomb energy Δ_c of ^{3}He and the probability $P_{\frac{3}{2}}$ of finding the ^{3}He in a $I = \frac{3}{2}$ state are calculated, using s-wave spin-dependent potentials of the Yamaguchi type to describe the two-nucleon interaction. This model yields values for Δ_c which are in reasonable agreement with the binding energy difference of ^{3}H and ^{3}He but predicts a negligible admixture of the $I = \frac{3}{2}$ state in the ^{3}He wave function. Finally, the possible relevance of hard-core effects and the non-separable Coulomb part of the p–p t-matrix is pointed out. (auth)

44754 (UCRL-50442) CALCULATION OF FORWARD BREMSSTRAHLUNG SPECTRA FROM THICK TARGETS. Dickinson, W. C.; Lent, E. M. (California Univ., Livermore. Lawrence Radiation Lab.). June 6, 1968. 26p. Dep. CFSTI.

Calculations of forward (0°), thick-target bremsstrahlung spectra were made for electron energies from 1 to 10 MeV and for a wide range of target Z. The effects of electron scattering, energy loss, collision straggling, transmission, and photon attenuation were included. Excellent agreement was obtained with the experimental results of Dance and co-workers for stopping targets of Al, Fe, Sn, and Au at energies of 1.0, 2.0, 2.8, and 3.0 MeV. Also good shape agreement was obtained with the measured spectra for 5- and 10-MeV electrons incident on a thick W target. (auth)

44755 VALIDITY OF THE BCS AND RPA APPROXIMATIONS IN THE PAIRING-PLUS-MONOPOLE SOLVABLE MODEL. Agassi, Dan (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Nucl. Phys., A116: 49-71(1968).

A solvable many-body model, which simulates qualitatively the main characteristics of the pairing-plus-quadrupole model, is presented and is investigated for systems of even and odd numbers of particles. The exact solution, when the force parameters are fixed and the number of particles is varied throughout the "major shell" of the model, is compared to the approximate BCS (or HB) solution for the ground state, and to the quasiparticle RPA result for the one-phonon excited states. It is concluded that the BCS (or HB) solution for the ground-state energy and wave function is good and practically exact if the number-of-particles projection is performed. The RPA for even systems seems to work for the so-called "pairing vibration" (0^+), whereas, for the model "quadrupole vibration", errors of about 20% of the exact excitation are encountered. For odd systems, a particle-conserving approximation for the corresponding quadrupole vibration is examined. (auth)

44756 TENSOR FORCE AND THE FADDEEV EQUATIONS. Fuda, M. G. (Rensselaer Polytechnic Inst., Troy, N. Y. State Univ. of New York, Buffalo). Nucl. Phys., A116: 83-96(1968).

A separable approximation to the two-nucleon t-matrix which includes some of the effects of the tensor force is derived. This approximation is found to be equivalent to using the Yamaguchi tensor potential. It is shown that the introduction of the operators of the permutation group S_3 into the Faddeev equations simplifies the handling of these equations. Taking advantage of this simplification, the Faddeev equations are then reduced to their simplest form using the separable approximation for the tensor force. (auth)

44757 SIMPLIFIED TREATMENT OF OCTUPOLE VIBRATIONS IN DEFORMED HEAVY NUCLEI. Faessler, A. (Univ., Freiburg i. B.); Plastino, A. Nucl. Phys., A116: 129-44(1968).

Some collective properties of nuclei belonging to the rare-earth and transuranic regions are described within the framework of the quasiparticle random phase approximation utilizing a pairing plus a state-independent octupole force model. Energies corresponding to the K = 0, 1, 2, and 3 octupole vibrational band heads and reduced electric octupole transitions to these bands are calculated. The results thus obtained are compared to the predictions given by the pairing plus octupole force and by the surface delta interaction. It is found that the extremely simple model proposed gives as good agreement with experiment as the other two models do. (auth)

44758 VIRTUAL STATES AND RESONANCES. McVoy, K. W. (Univ. of Wisconsin, Madison). Nucl. Phys., A115: 481-94(1968).

The distinction between an s-wave virtual state and a resonance is explained by exhibiting the characteristic phase shifts and scattering cross-section shapes attributable to each. They are described in both R-matrix and S-matrix terms, and the relation between these two parametrizations is explained. As an application, in the two succeeding papers, the energy dependence of the s-wave neutron strength function is investigated, and it is shown how it is affected by the presence of a virtual state in the complex optical potential. Such a state is expected to occur for A ≈ 50 and A ≈ 150, where the 3s and 4s optical states are slightly unbound. (auth)

44759 R-MATRIX AND S-MATRIX STRENGTH FUNCTIONS. McVoy, K. W. (Univ. of Wisconsin, Madison). Nucl. Phys., A115: 495-503(1968).

Strength functions are defined for both R- and S-matrices as the energy average of the ratio of pole residues to pole spacings. The R-matrix strength functions exhibit no threshold effects, while the S-matrix strength function for channel c considered as a function of the energy has a branch point at that channel threshold. Although the R strength function for l = 0 neutrons may exhibit a giant resonance as a function of energy just above neutron threshold (e.g., for A ≈ 55 and 155), the S strength function does not as a direct consequence of its threshold branch point. (auth)

44760 THRESHOLD CUSP IN THE S-WAVE NEUTRON STRENGTH FUNCTION. Goebel, C. J.; McVoy, K. W. (Univ. of Wisconsin, Madison). Nucl. Phys., A115: 504-15(1968).

The energy dependence of the l = 0, S-matrix neutron strength function is calculated in the scattering length approximation, both above and below neutron threshold and is found to exhibit a cusp exactly at threshold. Although only its upper half is accessible to neutron-resonance experiments, it should be observable in the spectroscopic factors extracted from (d,p) reactions leading to states of the final nucleus in the neighbourhood of neutron thresholds. It should be especially prominent for nuclei with A ≈ 55 and A ≈ 155, where the 3s and 4s single-particle states are virtual. (auth)

44761 THREE-BODY FORCES IN NUCLEAR MATTER. McKellar, Bruce H. J.; Rajaraman, R. (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev. Lett., 21: 450-3(Aug. 12, 1968).

The pionic three-body potential in nuclear matter is shown to be comparable with the two-body potential. (auth)

44762 SEPARABLE NUCLEON–NUCLEON POTENTIAL. Strobel, George L. (Univ. of Georgia, Athens). Nucl. Phys., A116: 465-72(1968).

A separable potential for the nucleon–nucleon interaction is presented, assuming form factors of the type: $g(k) = ak^L e^{-bk^2}$, where a and b are parameters adjusted to fit the experimental phase shifts. With this formulation, it is possible to reproduce the singlet and triplet scattering lengths and effective ranges as well as the elastic-scattering phase shifts up to 320 MeV for states containing L = 0 components. (auth)

44763 NOTE ON THE CORRELATION ENERGY OF A MANY-FERMION SYSTEM. Da Providencia, J. (Univ., Coimbra). Nucl. Phys., A116: 396-400(1968).

The RPA expression for the correlation energy is tested by applying it to a solvable model. The agreement with the exact results is very good and is improved if a correction term compensating for the violation of the Pauli principle is included. (auth)

44764 l-FORBIDDEN MAGNETIC DIPOLE TRANSITIONS. Freed, N. (Pennsylvania State Univ., University Park); Kisslinger, L. S. Nucl. Phys., A116: 401-7(1968).

The dependence of l-forbidden M1 transition rates on the effects of configuration mixing induced by short-range correlations and by collective quadrupole vibrations is studied in the context of the pairing-plus-phonon model. It is pointed out that the two types of contributions are often comparable in magnitude and must be considered simultaneously if detailed agreement with experiment is to be achieved. (auth)

44765 E2 TRANSITIONS IN NUCLEI. Lawson, R. D. (Weizmann Inst. of Science, Rehovoth, Israel. Argonne National Lab., Ill.). Nucl. Phys., A116: 363-8(1968).

If one assumes a single major oscillator shell to describe the properties of low-lying nuclear states, shell-model calculations on single-closed-shell nuclei or nuclei with $T_z = 0$ invariably predict the following result for doubly even nuclei: If one introduces an effective charge for the neutron and proton, the E2 transition rates between the lowest state with spin J_i (denoted by $J_i^{(0)}$) and the lowest state with spin J_f (denoted by $J_f^{(0)}$) are in good agreement with experiment. On the other hand, for $\Delta T = 0$ the E2 transition rate between the state $J_i^{(0)}$ and the state $J_f^{(k)}$ is quite small when $J_i \neq J_f$ and $k \neq 0$. (The superscript k denotes which of the many states with spin J_f we refer to –k = 0 means the lowest one, k = 1 the second state etc.) In this note, it is shown that the lack of an E2 component in the gamma transition $J_i^{(0)} \rightarrow J_f^{(k)}$ ($J_i \neq J_f$, $k \neq 0$) may be traced to an asymptotic selection rule which, although holding rigorously only when the nucleus has large deformation, persists to a high degree of approximation even when the nucleus is almost spherical. A strong E2 transition that violates this rule therefore indicates a form of core excitation different from that already included through the introduction of an effective charge. Thus, a measurement of B(E2) for such states provides a sensitive method of testing the "single major oscillator shell" assumption that goes into many shell-model calculations. (auth)

44766 FINITE-RANGE EFFECTS IN DIRECT REACTIONS AT LOW ENERGIES. Goldfarb, L. J. B.; Parry, E. (The Univ., Manchester, Eng.). Nucl. Phys., A116: 309-20(1968).

A simplified account is given of finite-range effects for direct reactions when proceeding at energies low enough that nuclear distortion may be neglected. The treatment is successful when applied to (d,p) and (t,d) reactions as well as to neutron tunnelling in heavy-ion reactions. (auth)

44767 THE (t,d) REACTION AT LOW ENERGIES. Goldfarb, L. J. B.; Parry, E. (The Univ., Manchester, Eng.). Nucl. Phys., A116: 289-308(1968).

Calculations for the (t,d) reaction at energies below the Coulomb barrier are both simpler and more reliable than is the case at higher energies. The differential cross section is found to differ from the expression derived from use of the zero-range approximation by simply a multiplicative factor N. Unlike the situation at higher energies, this factorization is not based upon mathematical convenience. The value for N depends critically on the choice of triton wave function, and, taking a wave function proposed by Tang et al., $N \approx 6.3$. The importance of this reaction lies in the possibility of extracting spectroscopic information concerning low-lying states of a variety of nuclei, if the experimentation is confined to low energies. In such an instance, most of the uncertainties associated with the use of the DWBA are no longer present. (auth)

44768 A SIMPLE THOMAS–FERMI CALCULATION FOR SEMI-INFINITE NUCLEI. Nemeth, Judit; Bethe, H. A. (Cornell Univ., Ithaca, N. Y.). Nucl. Phys., A116: 241-55(1968).

On the basis of the general Thomas–Fermi theory of nuclear structure developed by Bethe, the surface properties of large nuclei are calculated. The realistic nuclear forces of Reid are assumed. Tensor forces and short-range repulsion are replaced by density-dependent central forces; the central forces are assumed to consist of an even- and odd-state force, plus an extra force in the S-state. Two constants are adjusted to give the correct binding energy and density of nuclear matter. An integral equation for the nuclear density is obtained and solved approximately. The thickness of the nuclear surface turns out to be 2.2 fm, the surface energy 19.5 $A^{2/3}$ MeV, compared with the observed values 2.4 and 18.0. (auth)

44769 MAGNETIC MOMENTS OF NUCLEAR ISOSPIN DOUBLETS. Leonardi, Renzo (Univ., Bologna); Rosa-Clot, Marco. Phys. Rev. Lett., 21: 377-9(Aug. 5, 1968).

The magnetic moments of nuclear isospin doublets are examined under the assumption that $\vec{\mu} = \vec{\mu}_0$ (isoscalar) + $\vec{\mu}_3$ (isovector). For fixed J and P, the magnetic moments of nuclei with odd numbers of neutrons or protons all lie on two straight lines. The slope of the lines is approximately the same for any J and P. (auth)

44770 NUCLEAR WAVE FUNCTIONS FOR ARBITRARY NUMBER OF NUCLEONS. Simonov, Yu. A. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 7: 1210-20(June 1968). (In Russian).

The method of harmonic functions previously used to solve the problem of three and four nucleons is applied to the general case of arbitrary number of nucleons. Harmonic functions of three lowest degrees are constructed explicitly for a given number of particles A, and it is shown that they describe the usual shell structure of nuclei. The ideas underlying the basis of the independent-particle model, with the help of which one usually obtains the shells, are discussed. The ideas of the present approach taking into account the correlation of motion of all the nucleons simultaneously and also resulting in shells are discussed. (auth)

44771 EFFECT OF THE ONE-PARTICLE LEVEL DEGENERATION ON THE DENSITY OF NUCLEAR STATES. Shubin, Yu. N. Yadern. Fiz., 7: 1193-8(June 1968). (In Russian).

The semiempirical expression previously obtained for the density of states parameter of degenerate Fermi-systems makes it possible to estimate quantitatively the effect of occupation of the Fermi level on the density of excited states of atomic nuclei (the Rosenzweig effect). It is shown that the account of this effect considerably improves the agreement between the theory and the experimental data in the domain of light and intermediate nuclei ($A < 150$). The results of the calculations performed indicate that the splitting of the level with a given j which is due to the residual interaction is small as compared with the mean distance between degenerator one-particle levels in the shell model. (auth)

44772 CALCULATION OF INELASTIC NUCLEON SCATTERING ON BASIS OF THE GENERALIZED OPTICAL MODEL OF NUCLEUS. Averyanov, I. K.; Dzyuba, B. M.; Rybachenko, V. F. Yadern. Fiz., 7: 1221-3(June 1968). (In Russian).

Experimental data on inelastic nucleon scattering at 14 MeV with the excitation of the lower collective state in the nuclei of Mg, Si, S, Zn, Sn, and Pb are analyzed using the generalized optical model of nucleus with parameters from the conventional optical model. A satisfactory agreement with the experimental data is obtained. If the β parameters of the static or dynamical deformation of the nuclei are known (from experiments with charged particles or with the γ quanta), then one is able to predict rather accurately the differential cross sections of inelastic neutron scattering through the first collective level of the target nuclei at the neutron energy $\gtrsim 10$ MeV. (auth)

44773 NEUTRON TUNNELLING IN HEAVY-ION REACTIONS AND THE EXTRACTION OF NUCLEAR SPECTROSCOPIC FACTORS. Goldfarb, L. J. B.; Steed, J. W. (The Univ., Manchester, Eng.). Nucl. Phys., A116: 321-41(1968).

DWBA analyses are given of the $^{10}B(^{14}N, ^{13}N)^{11}B$ and $^{40}Ca(^{14}N, ^{13}N)^{41}Ca$ reactions, which both involve transitions to final ground-state configurations at energies considerably below the Coulomb barrier. The experiments at the lower incident energies are well-fitted, and the spectroscopic factors that are derived for the neutron states in ^{41}Ca and ^{11}B are consistent with those deduced from (d,p) stripping studies. A procedure is presented for handling the nuclear distortion effects at higher energies without the need for introducing optical models to account for the non-Coulomb interactions between the heavy ions and the target nuclei. The reliability of information derived from neutron-transfer experiments involving heavy ions is compared with that derived from the more conventional deutron-stripping experiments. (auth)

44774 REAL PART OF THE OPTICAL POTENTIAL IN PROTON–NUCLEUS SCATTERING. Slanina, D.; McManus, H. (Michigan State Univ., East Lansing). Nucl. Phys., A116: 271-80(1968).

The real parts of the central and spin-orbit optical potential are calculated for 40-MeV protons on ^{40}Ca, ^{58}Ni, ^{120}Sn and ^{208}Pb to first order in the two-nucleon effective interaction. Two estimates were used for the effective interaction. The first estimate was obtained from the impulse approximation and the second from the "bare" effective shell-model interaction as calculated by Kuo and Brown and by Green. (auth)

44775 SIMPLE MODEL FOR COMPARISON OF THE THEORIES OF HAUSER–FESHBACH AND P. A. MOLDAUER. Schmidt, F. (Univ., Stuttgart). Z. Naturforsch., 23a: 955-61(July 1968). (In German).

The theories of Hauser and Feshbach and P. A. Moldauer are compared by a simple two-channel model. It is found that after a good fit of parameters only the cross sections of compound-elastic scattering differ substantially. Most differences appear if there are a few open channels. The consequences for the cross section of compound-nucleus formation and also for calculations by the evaporation model are considered. By the model, an evident foundation is given for the statement that Moldauer's theories would by valid for $\langle \Gamma_{\lambda c} \rangle / D \leqq 1$. (auth)

44776 PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON NUCLEAR STRUCTURE, TOKYO, SEPTEMBER 7–13, 1967. Sanada, J. (ed.). J. Phys. Soc. Jap., 24: Suppl., 1-755 (1968). (CONF-670910).

The formal proceedings of the conference contain some special addresses, the full text of 69 papers, summaries of discussions, and abstracts of all the papers that were submitted to the conference. Title-list entries and subject indexing were previously prepared for 391 of the 419 published contributions (see NSA 22: 27279). In addition to the published contributions, 32 other papers have previously appeared in NSA; these papers may be located by referring to CONF 670910 in the report number index and to NSA 21: 31839, 33921, 35427, 38263, 38344, 44547, 44612, 44792, 46705, 46715, 46790, 46798, 46830, and 22: 1612, 3698, 3700, 3784, 3786, 5498, 7701, 9830, 9835, 9954, 27035, 27254, 30068, 35411. (D.C.W.)

44777 STUDIES IN ISOBARIC ANALOG RESONANCES. II. FINE STRUCTURE. Kerman, A. K.; de Toledo Piza, A. F. R. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Ann. Phys. (N.Y.), 48: 173-94(June 1, 1968). (MIT-2098-402).

The properties of the fine structure observed in connection with isobaric analog resonances in the elastic scattering of protons are examined in terms of the damping mechanism for the analog state. The observed asymmetries of the strength function are shown to be associated with phase correlations between damping and escape amplitudes. Correlations of the necessary type will possibly result from the virtual coupling through the open channel between the analog states and the nearby compound-nucleus states of normal symmetry. A brief discussion of the possible role of doorway states in feeding the latter is also given. (auth)

44778 TRANSMUTATIONS OF NUCLEI. Vintr, Z. London, Iliffe Books Ltd., 1968. 118p. 15s.

Translated from the Czech by P. S. Allen.

The subject is treated under the following headings: introduction; interaction of particles with matter; detection of nuclear radiation; radioactivity; and nuclear reactions. (UK)

44779 VELOCITY-DEPENDENT NUCLEON–NUCLEON POTENTIAL AND INTEGRAL CROSS SECTIONS OF DIPOLE PHOTO-ABSORPTION. Mamasakhlisov, V. I.; Djibuti, R. I.; Krupennikova, N. B. (Inst. of Physics, Tbilisi, USSR). Soobsch. Akad. Nauk Gruz. SSR, 49: 43-8(1968). (In Russian).

A study of the effect of the velocity-dependent potentials on the integral cross section of surface effects revealed that the contribution of these potentials and of the Majorana forces are nearly identical. This problem was further studied by investigating the role of velocity-dependent nucleon-nucleon real potentials on the integral cross section, considering the shell model with an oscillator potential and making use of the Green's potential involving Gaussian and exponential correlation with distance. Expressing the integral photoabsorption cross section by the mean value of the binary commutation of the Hamiltonian of the nucleus with the proton coordinates, the last term of the wave function of the ground state was determined by reducing the multiparticle matrix elements to two-particle matrix elements, i.e., to the two magic nuclei ^{4}He and ^{16}O, for which the calculation is greatly simplified. It was found that the velocity-dependent and Majorana forces derived on the basis of the Fermi-gas model are not equal for independent particles with oscillator potential. The values obtained for the ^{16}O nucleus, σ_0 = 398 MeV-mb and 410 MeV-mb, agree with experimental data. (TTT)

44780 S-WAVE SHAPE-DEPENDENT SCATTERING PARAMETERS OF THE PROTON–PROTON INTERACTION. Slobodrian, R. J. (Univ. of California, Berkeley). Phys. Rev. Lett., 21: 438-41(Aug. 12, 1968).

The shape-dependent parameters P and Q of the effective-range expansion for the S-wave p-p interaction were obtained from experimental data between 0 and 10 MeV, including recent results at 6.141, 8.097, and 9.918 MeV. The preferred best values are P = 0.072 ± 0.005 and Q = 0.034 ± 0.004. (auth)

44781 ON THE SPONTANEOUS FISSION OF NUCLEI WITH Z NEAR 114 AND N NEAR 184. Nilsson, S. G. (Univ. of California, Berkeley); Nix, J. R.; Sobiczewski, A.; Szymanski, Z.; Wycech, S.; Gustafson, C.; Moeller, P. Nucl. Phys., A115: 545-562(1968).

Theoretical calculations of the potential energy surface as a function of quadrupole and hexadecapole distortion parameters are reported for super-heavy nuclei with Z near 114 and N near 184. Estimates of spontaneous fission half-lives indicate a sizable island of relative stability in the vicinity of these closed-shell nucleon numbers. (auth)

44782 CALCULATION OF THE OPTICAL POTENTIAL AT 152 MeV. Tatischeff, B.; Willis, A. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys., A115: 593-610(1968). (In French).

Starting from free nucleon-nucleon phase-shifts, the nucleon-nucleus optical potential is calculated within the impulse approximation including multiple scattering terms (no free parameter). The results are presented for 152-MeV protons scattered by ^{4}He, ^{12}C, ^{24}Mg, and ^{28}Si nuclei and are compared for elastic scattering (and inelastic scattering using DWIA) with experimental results and predictions obtained with the usual phenomenological potentials. (auth)

44783 IRREDUCIBLE REPRESENTATIONS OF THE SEMI-DIRECT-PRODUCT GROUP $K_n = A_n : S_n$ AND THE HARMONIC-OSCILLATOR SHELL MODEL. Kramer, Peter (Univ. of Mexico Mexico City). J. Math. Phys. (N. Y.), 9: 639-49(Apr. 1968).

If A_n denotes the Abelian group of n × n unitary diagonal matrice and S_n the symmetric group represented by n × n permutation matrices, the set of elements ap with $a \in A_n$ and $p \in S_n$ form a group K_n which is the semidirect product of A_n and S_n. Irreducible representations of K_n and the chains $K_n \supset S_n$ and $U_n \supset K_n$, with U_n being the unitary group in n dimensions, are discussed with applications in the harmonic-oscillator shell model. (auth)

44784 SOME QUESTIONS OF THE THEORY OF DEUTERON FLUCTUATION. Toktarov, K. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 7: 85-8(1967). (In Russian).

In connection with an investigation of the emission of high-energy heavy fragments in nuclear fission, the fluctuation characteristics of the deuteron were studied. The mean-square fluctuation of the volume, the mean-square fluctuation of the deuteron density, and the probability of the contraction of the deuteron to given dimensions were determined. (tr-auth)

44785 SHAPES OF BETA-RAY SPECTRA. Daniel, H. (Max-Plack-Institut fuer Kernphysik, Heidelberg. CERN, Geneva). Rev. Mod. Phys., 40: 659-71(July 1968).

A survey of the existing data on the shapes of β-ray spectra is given, mostly from the experimental point of view. The majority of the empirical facts accumulated during the past 12 years is reproduced in tables. The problems of Fierz-type and energy-proportional deviations, time reversal, pseudoscalar-type interaction, conservation of vector and axial-vector currents, and neutrino degeneracy are treated. (auth)

44786 RESONANCE SCATTERING OF γ QUANTA ON NUCLEI WITH USE OF CONDENSED SOURCES. Kaipov, D. K.; Kosyak, Yu. G.; Shubnyi, Yu. K. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 7: 12-16(1967). (In Russian).

A theoretical calculation was made of the attenuation of the resonance effect for liquid and solid sources in comparison with gaseous sources for elements with β-γ^* decay schemes. A comparison was made of the results of the calculation with experimental data for specific elements, as a result of which was obtained the dependence of the total effective radius on the atomic weight. (tr-auth)

44787 PAIRING POTENTIAL AND TWO-NUCLEON TRANSFER REACTION. Kammuri, Tetsuo; Yoshida, Hiroshi (Osaka Univ.). Nucl. Phys., A117: 27-48(1968).

A simple model of two-nucleon transfer reactions such as (t,p) or (^{3}He,n) reactions is proposed. A function called pairing potential represents the coherent sum over various single-particle configurations of the captured nucleons, which appears in the usual DWBA amplitude for the ground state transition. Considering two extremes, a uniform distribution and a surface-peaked one, for the radial shape of the pairing potential, the differential cross sections for the (t,p) ground state transitions are calculated in the DWBA method. Transitions to pairing vibrational 0^+ states and shape-isomeric 0^+ states can be treated in the same manner. The method is extended to treat the transitions to vibrational or rotational 2^+ states by making the potential deformed in either a static or dynamic sense. The shapes of the angular distributions are quite insensitive to the shape of the form factor. Good agreements with experiments can be obtained. Finally the possibility to generalize the nucleon optical potential — Hartree–Fock potential in the lower order — to a Hartree–Bogoliubov type potential is discussed in order to clarify the experimental dominance of the (t,p) ground state transition. Equivalence of this generalized optical potential method with the present DWBA method is also shown. (auth)

44788 COUPLED-CHANNEL TREATMENT OF INELASTIC SCATTERING BASED ON MICROSCOPIC NUCLEAR DESCRIPTIONS. Glendenning, Norman K. (Univ. of California, Berkeley). Nucl. Phys., A117: 49-65(1968).

The coupled-channel formalism for treating inelastic scattering based on microscopic nuclear descriptions has been given. The truncations in both the scattering and structure calculations and how they lead to an effective interaction are discussed. The relevant content of nuclear models can be reduced to a set of amplitudes. These are exhibited explicitly for systems described in terms of two fermion degrees of freedom. The matrix elements appearing in the coupled equations can be developed as a polynomials, which is very convenient from the point of view of computer calculation. (auth)

44789 COMPARISON OF THEORETICAL CONVERSION COEFFICIENTS. Dingus, R. S. (Univ. of Aarhus, Denmark. Univ. of Colorado, Boulder); Rud, Niels. Contract AT(11-1)-535. Nucl. Phys., A117: 73-100(1968). (COO-535-577).

The tables of internal conversion coefficients by Rose and by Sliv and Band were compared, and the deviations were plotted for all 17,371 cases in which the parameters in the two sets of tables match. The mean value of $(\alpha_R - \alpha_{SB})/\alpha_{SB}$ is nearly zero, but the standard deviation is 17%. The deviations (excluding those caused by differences in models) in the K-shell are small (less than 2%) except for two regions where logical explanations exist. The deviations are large and systematic throughout the L-subshells. Many of the deviations are due to defective interpolations as a function of Z. Empirically screened (pure Coulomb) calculations, which include accurate finite-size corrections, indicate inaccuracies in the tables by Rose which appear to be associated with finite-size effects. These calculations also provide systematic information concerning a cancellation which greatly reduces the magnitude of conversion coefficients in certain regions of the L_1 subshell for electric transitions. The experimental anomalies recently reported for L-subshell ratios for pure E2 transitions are in such a region and are discussed. There are often large discrepancies between the two sets of tables at low energy. Two regions were found in which large inaccuracies apparently exist in the tables by Sliv and Band. The empirically screened program was found to be a means of accurately interpolating between values calculated with more sophisticated programs. (auth)

44790 EXACT CALCULATION OF PAIR PRODUCTION. Oeverboe, Ingjald; Mork, Kjell J.; Olsen, Haakon A. (Norges Tekniske Hoegskole, Trondheim, Norway). Ark. Fys. Seminar Trondheim, No. 10, 16p.(1968).

Positron spectra and total cross sections for pair production in the field of an atom are calculated for a range of values of the atomic number and for photon energies below about 2.5 MeV. Screening effects by the atomic electrons are neglected. Good agreement with earlier theoretical calculations and with available experimental results is obtained. (auth) (Norway)

44791 SPIN FLIPPING IN THE SCATTERING OF COLD NEUTRONS ON ORIENTED ATOMIC NUCLEI. Binder, K.; Rauch, H. (Oesterreichische Hochschule, Vienna). Nukleonik, 11: 113-16(June 1968). (In German).

The cross section and the spin-flip probability for polarized neutron scattering on oriented nuclei are calculated. The theory of perturbation including second-order terms is used. It is shown that the change of the scattering amplitude is even in this case small where a considerable energy change of the scattered neutrons, caused by the magnetic coupling of the nuclei, occurs. The measurement of internal magnetic fields is discussed as a possible application. (auth)

44792 ADIABATIC MODEL OF ASYMMETRIC FISSION. Dietrich, Klaus (Univ., Heidelberg. Kernforschungszentrum, Karlsruhe, Ger.). Z. Phys., 214: 503-10(1968).

An adiabatic mechanism leading to asymmetric fission is proposed. The rapid change from symmetric to asymmetric fission as a function of the mass-number is simply explained and related to the transition in the liquid drop model from dumbbell to cylinder-like shapes of the nucleus at the saddle point. (auth)

44793 NUCLEAR MATTER AND THE NONSTATIC CHARACTER OF THE NUCLEON–NUCLEON INTERACTION. Pearson, J. M. (Univ. of Montreal). Nucl. Phys., A116: 27-32(1968).

It has been apparent for a long time that even though the nucleon–nucleon interaction may be mainly static the singlet-even phase shifts impose a certain irreducible nonstatic character on the potential. A static potential consisting of a hard core, an OPEP tail, and a phenomenological Yukawa term adjusted to fit the ^1S data with precision is considered. To this static potential, a nonstatic component is added in order to fit the ^1D and ^1G data as well. The nonstatic character is represented in four different ways: by L-dependence of the hard-core radius, by L-dependence of the phenomenological Yukawa term, by a quadratic spin-orbit term, and by a velocity-dependent term. The role played in nuclear matter by each of these different possible minimal nonstatic components is then investigated by performing simplified calculations of the Wong type. In each case the effect is found to be negligible, if the single-particle potential is assumed to be zero in the intermediate states. (auth)

44794 PRACTICAL METHOD FOR THE TREATMENT OF NUCLEAR COLLECTIVE MOTIONS. Fujita, Jun-ichi (Indiana Univ., Bloomington). Phys. Rev., 172: 1047-57(Aug. 20, 1968).

A practical method using projection operators is proposed for the treatment of nuclear collective motions in discrete as well as continuous energy regions. Mathematical techniques which have been developed by Feshbach and his collaborators in formulating nuclear reactions are fully made use of. As a special case this method includes an approximation procedure using a commutator of the nuclear Hamiltonian and the relevant transition operator, previously developed and applied to the study of hindered β transitions. The relation between the present method and the one due to Tomonaga is discussed. (auth)

44795 THE DEVIATION OF THE MAGNETIC MOMENTS FROM THE SCHMIDT LINES INDUCED BY A NONLOCAL TWO-BODY POTENTIAL. Roehl, W. H. (Univ., Cologne. Institut de Physique Nucleaire, Orsay, France). Z. Phys., 215: 56-61 (1968).

A unitary transformed two-body hard-core potential contains nonlocal terms, which will produce a deviation of the magnetic moments from the Schmidt lines. These deviations were calculated for several nuclei up to ^{41}Ca using an oscillator basis, and they are positive for odd-neutron and negative for odd-proton nuclei. Thus it is not possible to describe the experimental deviation from the Schmidt lines; but for the magnetic moments of ^{13}C, ^{15}O, and ^{15}N, the only nuclei where the experimental values are outside of the Schmidt lines, these nonlocal terms yield the right magnitude in the right direction of the deviation.

44796 TRANSLATIONALLY INVARIANT DESCRIPTION OF PARTICLE-HOLE STATES. Mueller-Arnke, A. (Technische Hochschule, Darmstadt, Ger.). Z. Phys., 215: 62-76(1968).

A translationally invariant model is proposed which allows one to calculate one-particle excitations and dipole transition probabilities of closed-shell nuclei with inclusion of the continuum. The connection of this model with the nuclear shell model is shown, and it is applied to the calculation of the photodisintegration cross section of ^{4}He. (auth)

44797 PERTURBED ANGULAR CORRELATION OF NUCLEI COHERENTLY EXCITED BY PULSED-BEAM TECHNIQUES. Christiansen, J.; Mahnke, H.-E.; Recknagel, E.; Riegel, D.; Weyer, G.; Witthuhn, W. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Phys. Rev. Lett., 21: 554-6(Aug. 19, 1968).

A new resonance method is discussed which is suited for the investigations of hyperfine interactions of excited nuclear states with lifetimes longer than 1 μsec. A first experiment was performed on a 4-μsec state of ^{69}Ge. The g factor was determined as $g = -0.222 \pm 0.001$. (auth)

44798 EFFECT OF TENSOR FORCES ON NUCLEON SCATTERING IN NUCLEAR MATTER. Shadchin, S. A. (Kiev Inst. of Physics). Ukr. Fiz. Zh., 13: 943-50(June 1968). (In Russian).

The T-matrix determining the scattering amplitude of nucleons in nuclear matter is found for the cases when the nucleon interaction may be described by a noncentral separable potential. The scattering amplitude and its poles are studied as functions of the magnitude of nuclear density and the total momentum of a nucleon pair. In the Hartree–Fock approximation, the effect of repulsive and tensor forces upon the one-particle potential and the binding energy of a nucleon in the nuclear matter is evaluated. (auth)

44799 COLLECTIVE LEVELS OF EVEN–EVEN SPHERICAL NUCLEI. Korolev, A. M. (Kiev Inst. of Physics). Ukr. Fiz. Zh., 13: 959-64(June 1968). (In Russian).

Collective levels of even-even spherical nuclei are considered on the basis of a simple extra-pair model in which the pair interacts with the "magic" core of the nucleus and excites in it surface oscillations. A unified model of A. Bohr is used with the excitation of any great number of phonons being taken into account. It is shown that the energy levels approximately correspond to the oscillator spectrum with a decreased phonon energy. The levels with different nuclear moments J of two-phonon and three-phonon states split. The level order of a three-phonon triplet with a different J essentially depends on the distribution of "one-particle" extra-pair levels, and the position of the triplet levels may be fixed by means of three parameters of the theory. (auth)

44800 ON APPLICABILITY OF THE PERTURBATION THEORY FOR DESCRIPTION OF TENSOR SPIN–ORBIT INTERACTION IN AN OPTICAL MODEL. Levshin, E. B. (Kiev Inst. of Physics). Ukr. Fiz. Zh., 13: 975-83(June 1968). (In Russian).

A formulation of perturbation theory is developed for the description of elastic deuteron scattering by nuclei with spin-orbit and tensor forces being taken into account on the basis of an optical model. Numerical calculations of the magnitudes measured by the experiment in case of elastic deuteron scattering by ^{40}Ca and ^{12}C are presented as an example. The calculation results are compared with the experimental data. (auth)

44801 SOFT-CORE HAMADA–JOHNSTON NUCLEON–NUCLEON POTENTIAL. Rochleder, E. (St. John's Univ., Jamaica, N. Y.); Erkelenz, K. Phys. Rev., 172: 1013-14(Aug. 20, 1968).

The phenomenological Hamada–Johnston nucleon-nucleon potential is modified by replacing the singular hard core with a soft core of the centrifugal type (r^{-2}). It is shown that the fits to experimentally determined elastic scattering phase shifts and deuteron data are little affected by such a modification. (auth)

44802 SELF-CONSISTENT THEORY OF NUCLEAR SPECTRA: PAIRING-FORCE MODEL. Dang, Giu Do (Physique Theorique et Hautes Energies, Orsay, France); Dreizler, R. M.; Klein, Abraham; Wu, Chi-shang. Phys. Rev., 172: 1022-31 (Aug. 20, 1968). (NYO–2171–243).

In prior work, the pairing interaction was studied by means of the equations of motion satisfied by the matrix elements of single-fermion operators (coefficients of fractional parentage). The previous numerical calculations incorporated approximations which we seek to avoid here by developing a self-consistent theory fully consonant with the intrinsic structure of the equations of motion and associated conditions. Unlike other methods, where a distinction is usually made between the ground state and other low-lying excited states, the subspace defined by all these states on an equal footing is considered. An elaborate self-consistency procedure is designed with the following salient features. The Hamiltonian is rendered diagonal in a subspace of states of both an even and a neighboring odd nucleus. The Pauli principle, as represented by sum rules imposed on the coefficients of fractional parentage, is satisfied as accurately as possible in a least-squares sense. The number of particles is conserved exactly in all states of the system. Results of calculation for a simple model are compared with exact solutions and found to be vastly improved over previous results. The exact results were obtained by means of a new self-consistent version of exact shell-model diagonalization, which is described. (auth)

44803 CALCULATION OF THE CROSS SECTION FOR DIRECT PAIR PRODUCTION BY ELECTRONS WITH TOTAL ENERGIES 5.511 AND 32 MeV IN A STATIC COULOMB FIELD. Loens, K.

(Physikalisch-Technische Bundesanstalt, Brunswick). Z. Phys., 215: 1-16(1968). (In German).

Differential cross sections for direct pair production by electrons with total energies E_0 = 5.511 and 32 MeV in copper are calculated in lowest order of perturbation theory and Born approximation, including the matrix elements of the electron exchange effect. Integration over particle angles and, in the case of E_0 = 32 MeV, over the energy of one outgoing electron was performed numerically on an IBM 7044 computer by using Gaussian quadrature formulas in FORTRAN programs. The results for E_0 = 5.511 MeV show a severe reduction of the differential cross section due to the exchange effect, while the results for 32 MeV are in fairly good agreement with the pair production experiment performed by Criegee in 1959. (auth)

REACTOR TECHNOLOGY

Central Power Reactors

Refer also to abstracts 42670, 42809, 42813, 42867, 42936, 43157, 43540, 43578, 43615, 43620, 43642, 43952, and 44880.

44804 (AE-318) A STUDY OF THE TEMPERATURE DISTRIBUTION IN UO_2 REACTOR FUEL ELEMENTS. Devold, I. (Aktiebolaget Atomenergi, Stockholm (Sweden)). May 1968. 82p. Dep.

A study of the thermal behavior of uranium dioxide in the form of reactor fuel is presented. Measurements performed at the OECD Halden Reactor Project, Halden, Norway, are described. The experiment was originally set up in order to measure the temperature at the center of a UO_2 fuel element as a function of element power, in order to determine the safe operation limit of the fuel assembly. However, in analysing the data obtained, very interesting thermal conductivity values were obtained and comparison with existing correlations could be performed. This comparison shows that a certain agreement is obtained between the measured data at Halden and a theory published by J. L. Bates in 1961, which predicts an increase in the thermal conductivity above 1500°C. The data obtained below 1300°C are also in good agreement with measurements performed by Vogt, Grandell and Runfors in 1964. A mathematical description of the heat transfer mechanisms in cylindrical fuel elements is presented. The model is coded in FORTRAN IV-code and referred to as FUELTEMP. (auth)

44805 (AE-325) SOME COMPARISONS OF MEASURED AND PREDICTED PRIMARY RADIATION LEVELS IN THE AGESTA POWER PLANT. Aalto, E.; Sandlin, R.; Krell, A. (Aktiebolaget Atomenergi, Stockholm (Sweden)). May 1968. 42p. Dep.

Neutron fluxes and γ exposure rates in the primary shields of the Agesta nuclear plant have been measured and the results compared with values predicted during shield design, and with values obtained later by the NRN bulk shielding code. The input data for the problems are given. The radial predictions are conservative by a factor of not more than 2 close to the reactor and by an unknown, higher factor further out. The conservatism is explainable by the differences between the true local conditions and core power distributions and those assumed in the predictions. The axial flux levels based on streaming calculations are found to agree with the estimated values. The conservatism here is not so large and it seems to be necessary to be very careful when handling streaming problems. The experience gained shows that a power plant is less suitable for studying the accuracy of the shield design codes as such, but the practical results from the combined application of massive shield codes and void streaming predictions to complicated problems give information about the true degree of conservatism present. (auth)

44806 (ANL-Trans-652) RESONANCE ABSORPTION IN REACTORS WITH A VERY LARGE DISTANCE BETWEEN THE BLOCKS. Galanin, A. D. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from report ITEF-518. 17p. Dep. CFSTI.

In designing the gas-cooled heavy water-moderated reactor it appears necessary to consider lattices with very large pitches. In such lattices the slowing down density will be constant across the cell and therefore the resonant absorption will not change inversely proportional to the moderator volume of the cell. The dependence of $1-\zeta$ on the lattice pitch is clarified. It is shown that if the ratio of the fuel element volume to the cell one is not smaller than 0.2 and the cell volume is not more than 1500 cm^2 (for the heavy water reactor) then the correction to the lumped part of resonant absorption is not more than 1.5% and to not-lumped one is not more than 20% (resonant absorption increases). Diagrams of corrections as a function of the cell volume at fixed ratio of fuel element and cell volumes are given. (auth)

44807 (APDA-221) OPERATIONAL SHIELD TESTS FOR THE ENRICO FERMI ATOMIC POWER PLANT. Beaudry, R. J. (Atomic Power Development Associates, Inc., Detroit, Mich.). July 1968. 205p.

A radiation and shield test program was conducted for the Enrico Fermi fast reactor during the period of August 19, 1963 to October 19, 1966. Particular emphasis was given to the measurement of neutron levels throughout the reactor building, both in the reactor vessel and throughout the shield system. General radiation surveys were also made throughout the entire plant. The results of these tests showed that the Fermi shield system was performing as well as or better than originally designed. All of the shield systems appeared to have been well designed and built, and no unexpected regions of high radiation or streaming were found. The induced radioactivities of the Na coolant and cover gas were measured, as well as the activities of fuel subassemblies and various metallic objects in the reactor vessel. The majority of the measured neutron levels and induced radioactivity levels were close to or somewhat less than the original design values, although they were in close agreement with more recently calculated values. (auth)

44808 (APDA-308) DEVELOPMENT OF THE PRIMARY SYSTEM FOR THE ENRICO FERMI ATOMIC POWER PLANT. Peters, N. T. (Atomic Power Development Associates, Inc., Detroit, Mich.). June 1968. Contract AT(11-1)-865. 173p. Dep. CFSTI.

The course of development of the primary heat transport system of the Enrico Fermi reactor is described. The construction, testing, and operation of the system with reactor power levels up to 100 MW(t) are also discussed. An evaluation of the general performance and important features and characteristics of the system, including recommendations for use in the future design of new liquid-metal cooled fast breeder reactor power plants, is presented. The interaction of the primary system design with the design of other features of the plant, such as the reactor containment building, is also documented. System components and auxiliary features are described only to the extent that they are relevant to the discussion of the design of the primary system as an integrated, functional unit. (auth)

44809 (BNWL-789) RODCOST: A PROGRAM FOR CALCULATING THE COST OF FABRICATING UO_2 AND PuO_2–UO_2 FUEL RODS AS A FUNCTION OF DESIGN. Simmons, G. L.; Cole, B. M.; Burnham, J. B. Jr. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). June 1968. Contract AT(45-1)-1830. 24p. Dep. CFSTI.

A computer code that calculates the cost of fabrication of fuel elements for both pressurized and boiling light water reactors is described. A one tonne per day plant and vibratory compacted fuel are assumed. Cost relations are developed based on the work of Burnham et al. Information is given to allow the use of this code as a subroutine in a larger program. (auth)

44810 (BNWL-SA-1736) ABSORPTION BY REACTIVE SPRAYS WITH APPRECIABLE LIQUID PHASE MASS TRANSFER RESISTANCE: THE WASHOUT OF METHYL IODIDE BY REACTIVE SPRAYS. Postma, A. K.; Schwendiman, L. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 1, 1968. Contract AT(45-1)-1830. 25p. (CONF-680811-4). Dep. CFSTI.

From Symposium on Operating and Developmental Experience in the Treatment of Airborne Radioactive Wastes, New York.

Sprays hold promise of efficiently and rapidly removing airborne fission products, following loss-of-coolant in a reactor and release of fission products in a containment vessel. Although reactive sprays have been demonstrated for removing molecular radioactive iodine, the application of sprays to the less reactive methyl iodide known also to be present has received less attention. A study was made of the washout of organic iodides by reactive liquid sprays. Although the reactive additive used was hydrazine, the results would be applicable to other additives. Liquid phase mass transfer resistance plays a large role in the absorption of relatively insoluble substances such as methyl iodide even when the absorbed gas reacts quite rapidly within the liquid phase. At very low absorbate concentrations such as expected in post-accident atmospheres the liquid phase chemical reactions would be expected to proceed according to first order rate laws. Falling drop absorption was calculated, assuming surface saturation and first order reaction rates, for stagnant and well mixed drops. For drops having diameters smaller than about 500 microns, and for reaction velocities less than 100 sec^{-1}, the two models gave predicted removal rates which were similar. Computer evaluation of the infinite series solution to the absorption equation was carried out for a range of drop sizes, temperature, fall heights, and reaction velocities. Absorption by liquid wall films is an important part of the overall absorption for the spray systems described. The penetration theory model of absorption into flowing films was used to predict wall film absorption. The overall absorption model thus accounts for absorption by drops and wall film. The washout of methyl iodide by aqueous hydrazine sprays was measured in spray chambers approximately 4 ft. in diameter by 10 ft. tall. Measured washout half-times ranged from 8 minutes to several hours, depending on the spray rates, hydrazine concentrations, and temperatures. Collection of the drops and wall liquid permitted measurement of the relative importance of wall and drop absorption in these experiments. Based on the absorption model developed and the experimental results, the removal rate of methyl iodide in larger containment systems was predicted for a range of drop sizes, reaction velocities, temperatures, and vessel heights. (auth)

44811 (CONF-660521-6) FUEL CENTRE TEMPERATURE MEASUREMENT IN DFR AND DMTR. Fisher, L.; French, G. (United Kingdom Atomic Energy Authority, Dounreay (Scotland). Reactor Group). [nd]. 7p. Dep. CFSTI. UK.

From International Symposium on In-Pile Irradiation Equipment and Techniques, Harwell, Eng.

The centre temperature of a mixed oxide fuel pin in DFR has been monitored using a W–Re alloy thermocouple over a period of 14 weeks at nominally 1400°C. The results and the mode of final failure are discussed. Fabrication techniques for this and for similar experiments to be mounted in DMTR are described. (auth)

44812 (DOCKET-50231-20) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Facility Description and Safety Analysis Report, Amendment 18, Suppl. 18. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Aug. 9, 1968. 57p. Dep. CFSTI.

Detailed analyses of the consequences of a guillotine type break in the main primary cooling system are given. Control of the valves for the waste gas batch tanks is discussed. Operation of personnel and equipment doors and hatches is described in detail; other containment penetrations are discussed. Dynamic loadings on core support structure and reactor vessel caused by the maximum planned transient are analysed. Installation and removal of experimental equipment is described. Design data on the Fast Reactivity Excursion Device (FRED) are given. (M.L.S.)

44813 (DOCKET-50313-10) RUSSELLVILLE NUCLEAR UNIT. Preliminary Safety Analysis Report, Suppl. 7. (Arkansas Power and Light Co., Little Rock). Aug. 16, 1968. 38p. Dep. CFSTI.

Detailed information on the prestressing tendons for Class I structures for Russellville Power Reactor is given. The anchorage zone design for prestressing tendons is detailed; large size prestressing tendons are described. Design of liner plate anchors is discussed. (M.L.S.)

44814 (DOCKET-50315-8) DONALD C. COOK NUCLEAR PLANT. [Preliminary Safety Analysis Report], Amendment 4. (Indiana and Michigan Electric Co., Fort Wayne, Ind.). Aug. 2, 1968. 154p. (DOCKET-50316-8). Dep. CFSTI.

Detailed discussions are given for the Donald C. Cook Power Reactor, Units 1 and 2. The ice condenser system is described in detail; design parameters are tabulated. Blowdown and containment pressure transient analyses are detailed. Containment integrity is evaluated. Auxiliary building ventilation systems are described. (M.L.S.)

44815 (EURFNR-502) NUMERICAL INVESTIGATIONS INTO METHODS OF CRITICALLITY AND BREEDING RATES CALCULATION FOR REACTORS WITH CYLINDER GEOMETRY AND PARTIALLY INSERTED CONTROL RODS. Schwetje, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Translation of report KFK-741. 33p. (EUR-3723). Dep. CFSTI.

Work performed under United States–Euratom Fast Reactor Exchange Program.

In the calculation of characteristic values and integral rates for cylindrical reactors with wholly or partially inserted guide rods by means of zero, one and two-dimensional diffusion codes the method of N. Spinks offers advantages compared with previous methods both as regards precision and the calculation time. The application of this method is simple. The precondition for good results is a reactor configuration with at least six control or shutdown rods at the same distance from the core center. The most recent designs for fast breeders always provide, with steam and with Na cooling, six or more rods at the same interval from the core center. Thus, in the calculation of these reactors Spinks' method can be applied. Investigations concerning the dependence of the breeding rates on the depth of insertion of the guide rods and on the excess reactivity show that movements of the guide rods during reactor operation have only a small influence on the breeding rates, but that changes in the excess reactivity because of change in the enrichment have a considerably stronger influence on the breeding rate. Therefore, realistic breeding rates are obtained only when these are calculated for the proper excess reactivities. (auth)

44816 (EURFNR-522) 1000 MWe STEAM COOLED FAST REACTOR WITH PRESTRESSED CONCRETE VESSEL. Chermanne, J.; Henriette, J. (Societe Belge pour l'Industrie Nucleaire, Brussels). Dec. 1967. Contract 015-65-1-RAPB. 63p. (BN-6712-15). Dep.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

A design concept for a 1000 MW(e) steam cooled fast breeder with the core, circulators, and steam generators enclosed in a prestressed concrete vessel is presented. Basic design characteristics of the plant components and systems are described, and safety problems associated with depressurization and loss of coolant flow are examined. The economics of the concept are estimated and compared to those of a reactor of similar size utilizing a steel pressure vessel. (H.D.R.)

44817 (GA-8667) GAPER: A TRANSPORT PERTURBATION THEORY PROGRAM. Sargis, D. A. (Gulf General Atomic, Inc., San Diego, Calif.). Apr. 26, 1968. Contract AT(04-3)-167. 83p. Dep. CFSTI.

A computer program GAPER has been written to evaluate reactivity coefficients in reactor assemblies using first order transport perturbation theory. Scalar neutron fluxes and currents, as computed by S_n transport calculations are utilized with leakage and anisotropic scattering effects treated in a P_1 approximation. GAPER computes contributions to the change in inverse multiplication factor $\Delta(1/k)$ due to perturbations in the individual capture, net fission, total scattering, (n,2n), inelastic scattering, and leakage cross sections. The program assumes that the fluxes and currents are separable and may be combined in an elementary synthesis scheme for two- and three-dimensional problems. A multidimensional prompt neutron lifetime calculation is also available. Numerical results compare favorably with transport calculations and are superior to all diffusion theory problems considered. Computer running times for the perturbation method are much faster than direct transport or diffusion theory calculations. A sample problem is solved. Input and output formats are shown. (auth)

44818 (GAMD-8552) FORT ST. VRAIN PROOF TEST ELEMENT NUMBER ONE. Hooker, J. R.; Grenda, R. J.; Luby, C. S.; Mills, R. G. (Gulf General Atomic, Inc., San Diego, Calif.). June 12, 1968. Contract AT(04-3)-633. 109p. Dep. CFSTI.

The materials and processes used in the fabrication of the proof test element, including the characterization of the coated fuel particles and fuel rods, the piggyback irradiation specimens, and the assembly of the element are described. (auth)

44819 (GEAP-4881) SODIUM MASS TRANSFER. XXIII. MODEL FOR CORROSION MOCKUP OF SODIUM COOLED REACTORS. Lockhart, R. W.; Blair, R. C. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). July 1967. Contract AT(04-3)-189. 85p. Dep. CFSTI.

A method of providing a corrosion mockup for a large sodium system is presented. The mockup loop is so designed that the corrosion processes provide the same amount of change in solute, ΔS, (corroded material) in specified locations in the mockup as would be expected in a large plant system. It is proposed that the effects of sodium exposure in the mockup will be identical to that in the large system which may be 10 to 100,000 times larger in capacity. The ΔS analysis of eight of the Mass Transfer Program's original 40 test runs and the analysis of the four conceptual designs of 1000 MW(e) sodium cooled fast reactors in the 1964 AEC study are presented as examples of applying the model. (auth)

44820 (GEAP-5508) SODIUM COMPONENTS DEVELOPMENT PROGRAM. MASS TRANSFER INVESTIGATIONS IN LIQUID METAL SYSTEMS. Quarterly Progress Report No. 1, March–May 1967. Young, R. S. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). June 1967. Contract AT(04-3)-189. 73p. Dep. CFSTI.

STAINLESS STEEL — corrosion by liquid sodium of Type 304 and Type 316, effects of exposure time, flow rate, and temperature on; corrosion by 1300°F liquid sodium of electron bombardment heater anode of Type 316, analysis of; corrosion by liquid sodium at 1300°F of cladding material of Types 304, 316, and 347, analysis of; fabrication of liquid sodium sampling device from Type 304, description of

SODIUM — corrosive effects on Type 304 and Type 316 stainless steels of liquid, effects of, exposure time, flow rate, and temperature on; corrosive effects on Type 316 stainless steel anode 0.5 to 1 × 10^6 Btu/h-ft^2 electron bombardment heaters at 1300°F of liquid, analysis of; corrosive effects on Incoloy 800 and Types 304, 316, and 347 stainless steel cladding at 1300°F of liquid, analysis of; plugging indicator for liquid, description of; purification of liquid, analysis of cold trap

HEATERS — configuration of Type 316 stainless steel anode 0.5 to 1 × 10^6 Btu/h-ft^2 liquid sodium electron bombardment at 1300°F, description of; corrosion testing of Type 316 stainless steel anode 0.5 to 1 × 10^6 Btu/h-ft^2 liquid sodium electron bombardment at 1300°F, analysis of
INCOLOY 800 — corrosion by liquid sodium at 1300°F of cladding material of, analysis of
SAMPLING — device for liquid sodium, description of test loop Type 304 stainless steel
TRAPS — performance of liquid sodium cold, analysis of

44821 (GEAP-5546) SODIUM COMPONENTS DEVELOPMENT PROGRAM MASS TRANSFER INVESTIGATIONS IN LIQUID METAL SYSTEMS. Quarterly Progress Report No. 2, June–August 1967. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Sept. 1967. Contract AT(04-3)-189. 68p. Dep. CFSTI.

REACTORS, BREEDER — fuel element cladding materials for LMFBR, corrosive effects of liquid sodium on
REACTOR FUEL ELEMENTS — cladding materials for LMFBR reactor, corrosive effects of liquid sodium on
INCOLOY 800 — corrosion by liquid sodium, effects of pressure and exposure time at 1300°F on
STAINLESS STEEL — corrosion by liquid sodium of Type 304, Type 316, and Type 347, effects of pressure and exposure time at 1300°F on
SODIUM — corrosive effects on Type 304, Type 316, and Type 347 stainless steel and Incoloy 800 of liquid, analysis at 1300°F of; impurities in liquid, analysis of test loop carbon and metallic (D.C.C.)

44822 (GEAP-5582) SODIUM COMPONENTS DEVELOPMENT PROGRAM. MASS TRANSFER INVESTIGATIONS IN LIQUID METAL SYSTEMS. Quarterly Progress Report No. 3, September–November 1967. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Jan. 1968. Contract AT(04-3)-189. 45p. Dep. CFSTI.

Investigations of materials exposure, mechanical properties, and Na impurities effects in pumped Na systems operating under controlled purity conditions to maximum temperatures of 1300°F are examined. Preparations were completed for testing of Type 304 stainless steel in a loop modified to simulate typical closed loop conditions of FFTF. The design details and corrosion test conditions are given along with a schematic representation of the modified test loop and specimen locations. The successful attainment of long-term operation with heat fluxes on the order of 1 × 10^6 Btu/hr-ft^2 with an electron bombardment heater simulating typical fuel cladding exposure in flowing Na is reported. Stable heater operation was obtained for bulk Na temperatures to 1200°F for ~1100 hours, and operation continues. Work was completed on data analysis and reporting of Na vapor transport and deposition rates and Na fog production experiments in a refueling cell mockup containing a 4-foot diameter open pool of liquid Na. Short time stress-rupture tests of LMFBR cladding candidates weld drawn and annealed, were conducted to establish probable mode and relative rates of failures of tubing currently in test in Na loops and irradiation capsules. Results indicate that weld drawn Types 304 and 316 stainless steels should yield representative and uniform properties. Type 347 stainless steel and Incoloy 800 in the weld drawn condition, because of localized seam weld deformation, do not produce homogeneous mechanical property data. Further use of these materials in weld drawn tubing form is discouraged and seamless materials have been procured for future tests. Plugging mechanism studies in mass transfer loops confirm that hydrogen compounds are responsible for the high temperature break in the plugging indicator. (auth)

44823 (HPR-77) DEVELOPMENT OF IN-PILE BURN-OUT DETECTORS. Schenk, K. (Institutt for Atomenergi, Halden (Norway). OECD Halden Reaktor Prosjekt). Mar. 1967. 35p. Dep.

Three types of burn-out detectors are developed for in-pile use: measurement of fuel can elongation with a differential transformer; measurement of the electrical resistance of the fuel canning; and measurement of the insulation resistance of a coaxial cable installed in grooves in the fuel pellets. In-pile tests and application show the detectors to be reliable, simple to use, and capable of protecting fuel assemblies against damage due to fuel canning overheating at critical heat flux conditions. (auth)

44824 (HPR-100) IRRADIATION EXPERIENCE WITH THE FIRST UO_2 ALUMINIUM CLAD FUEL ASSEMBLY TESTED IN HBWR. Videm, K.; Aas, S.; Hanevik, A.; Jensen, E. (Institutt for Atomenergi, Halden (Norway). OECD Halden Reaktor Prosjekt). May 1968. 31p. Dep.

The reactor experience with the first Al clad fuel element tested under HBWR conditions is described. The cladding alloy used had the following composition: 1% Ni, 11% Si, 0.5% Fe, 0.8% Mg, 0.1% Ti, balance Al. After a total irradiation time of 140 days, corresponding to an integrated power of 730 MWd/t at two channel power levels, one of the stringers failed at two bulb-shaped distortions, one at either end of the stringer. The primary reason for the failure was corrosion of accidental inclusions of pure Al in the Al alloy cladding. The bulb-shaped distortions were caused by reaction between the thermal isolation pellets of MgO and the in-leaked water. The general behaviour of the other stringers was satisfactory. Based on the experience with these elements two new assemblies have been made and are being irradiated. The maximum heat fluxes are 65 W/cm^2 and 140 W/cm^2 respectively, and the integrated powers 5900 MWd/t and 5600 MWd/t as of August 1966. (auth)

44825 (KFK-751) INFLUENCE OF THE INTERNAL GEOMETRY ON THE RADIAL TEMPERATURE DISTRIBUTION OF FAST BREEDER FUEL ELEMENTS. Kaempf, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Feb. 1968. 34p. (In German). (EUR-3710). Dep.

The development of a fast reactor fuel element model for investigation of effects of internal geometry on temperature distribution is described. Heat balance equations are formulated; equations describing homogeneous and inhomogeneous porosity distributions are given. The conductivity of stoichiometric uranium dioxides is shown as a function of temperature with porosity as a parameter. Effects of thermal splitting on the fuel rods are analyzed. 18 references. (M.L.S.)

44826 (LA-DC-9483) EFFICIENCY TESTING THE AIR CLEANING SYSTEM FOR A HIGH TEMPERATURE REACTOR. DeField, James D.; Ettinger, Harry J. (Los Alamos Scientific Lab., N. Mex.). [1968]. Contract W-7405-eng-36. 20p. (CONF-680811-2). Dep. CFSTI.

From Symposium on Operating and Development Experience in the Treatment of Airborne Radioactive Wastes, New York.

The Los Alamos Ultra High Temperature Reactor Experiment (UHTREX) utilizes a helium cooled, graphite moderated reactor, employing refractory fuel elements. Under accident conditions, the effluent that may be released from this reactor requires an air cleaning system capable of reducing radioactive gas and particulate contaminants to safe levels. Diotyl phthalate and iodine-131 were used as test aerosols for the HEPA and activated carbon filters, respectively. Methods of aerosol generation and test procedures are detailed for the preinstallation tests of the carbon and in-place testing of the carbon and HEPA filters. The importance of visual inspection of the HEPA filters prior to installation and supervision of filter installation is discussed. In-place tests indicated desirable design changes which would (1) simplify in-place testing procedures, (2) expedite installation and future changing of the filters, and (3) assure operation of a more efficient system. Problems encountered during in-place testing, recommendations for the design of similar systems, and acceptance criteria used at LASL are discussed. (auth)

44827 (ORNL-TM-2316) PHYSICAL PROPERTIES OF MOLTEN-SALT REACTOR FUEL, COOLANT, AND FLUSH SALTS. Cantor, S. (ed.) (Oak Ridge National Lab., Tenn.). [1968]. Contract W-7405-eng-26. 49p. Dep. CFSTI.

For seven molten salt mixtures: four fuel mixtures, each containing LiF, BeF_2, ThF_4, UF_4, one flush salt, LiF–BeF_2 (66–34 mole %), two coolant salts, $NaBF_4$–NaF (92–8 mole %) and single-component $NaBF_4$, estimates and/or experimental values are given for the following properties: viscosity, thermal conductivity, electrical conductivity, phase transition behavior, heat capacity, heat of fusion, density, expansivity, compressibility, vapor pressure, surface tension, and solubility of the gases, He, Kr, Xe, BF_3. From the foregoing properties, the following have also been calculated and appended: isochoric heat capacity (C_v), sonic velocity, thermal diffusivity, kinematic viscosity, and Prandtl number. (auth)

44828 (ORNL-tr-1966a) DESIGN OF THE INTEGRATED PRIMARY CIRCUIT OF THE EDF-4 REACTOR. Brignon, P.; Gaussot, D. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Paper EN-1/8 of ENEA Symposium on the Technology of Integrated Primary Circuits for Power Reactors, Paris, May 20–22, 1968. 10p. (CONF-680525-1). Dep. CFSTI.

By integrating the primary circuit in the pressure vessel, the external CO_2 circuit and associated shielding can be dispensed with. Such an arrangement is possible if prestressed concrete techniques are used. Several different designs are feasible, depending on the pressure vessel geometry, possibility of access, and the configuration of the items inside the vessel. For reasons connected with construction, a vertical cylindrical pressure vessel was quickly decided upon for EDF 4. The internal equipment could be arranged in several ways: the heat exchangers could be located above, below or around the reactor. The decision to use the EDF 3 design of fuel handling mechanism ruled out the first alternative. The second option was adopted, in view of the smaller internal diameter and the uniform temperature of the pressure vessel walls, and because simple answers were found to the problems it raised, namely, that of supporting the reactor, and the fact that the internal units would have to be installed one after another. Problems connected with the direction of the CO_2 flow were also examined. The dimensions and location of the access ports represent a compromise between the limitations imposed by the construction of the pressure vessel and the possibility of dismantling the various items. Most of the equipment inside the pressure vessel being of the static type, little wear takes place and maintenance is minimal provided that the specifications as to quality are fairly strict. Despite the precautions taken in this respect with EDF 4, some jobs can be done inside the pressure vessel in that 2 openings 2 meters in diameter provide access, with a suitable conditioned atmosphere. Moreover, it is possible (though not easy) to replace all the heat exchangers. The blowers, on the other hand, are easily reached, and they can be removed without difficulty. (auth)

44829 (ORNL-tr-1966b) PROBLEMS ASSOCIATED WITH THE STRUCTURE OF PRESSURE VESSELS FOR WATER- AND GAS-COOLED REACTORS. Bernaix, J.; Picaut, J.; Puyo, A. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Paper EN-1/5 of ENEA Symposium on the Technology of the Integrated Primary Circuits for Power Reactors, Paris, May 20–22, 1968. 5p. (CONF-680525–5). Dep. CFSTI.

Irrespective of the type of reactor, the walls of the prestressed concrete pressure vessel are provided with various openings and have pipework passing through them. For instance, there are the fuel-handling and control rod ports in the cover slabs, and the passages for the turbo-blowers and the heat exchanger inlets and outlets through the cylindrical wall. If the seal between these various pipes etc. and the liner is not provided at the inner wall of the pressure vessel, the prestressing forces required will be much higher. All the penetrations must be provided with thermal insulation and cooling, which takes up considerable space. Hence there is less room for the prestressing cables. It follows that whenever possible cables should not pass through the slabs, and sufficiently strong cables should be used in order that they need not be too close together. Circumferential tendons and very strong longitudinal cables would seem to be a suitable method of prestressing. The distance between 2 successive tendons around the vessel wall is about 1 meter, which is sufficient for most of the orifices. The bottom sections are prestressed solely by circumferential cables. The prestressing tendons can quickly be tensioned and released, and it is therefore relatively simple to open up the pressure vessel if such a step should be necessary. It is difficult to calculate the influence of passages and openings on local stresses in the concrete calculation, and it would seem that this is best investigated by means of large-scale concrete mock-ups. Initially, much less costly experiments are being conducted with $\frac{1}{25}$th scale plaster models. (auth)

44830 (ORNL-tr-1966c) THERMAL INSULATION OF PRESTRESSED CONCRETE PRESSURE VESSELS USING METAL GAUZE AND FOIL. Arathoon, J.; Breuille, M.; Lecourt, Y. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Paper EN-1/2 of ENEA Symposium on the Technology of the Integrated Primary Circuits for Power Reactors, Paris, May 20–22, 1968. 10p. (CONF-680525–4). Dep. CFSTI.

The thermal insulation system is described in which stainless steel gauze mattresses are separated by layers of stainless steel foil; these layers prevent any sizeable heat transfer from one mattress to the next. The mattress and foil sandwich assembly is slightly compacted by sturdy protective sheeting. Although produced in small panels (1 × 1.5 m) making for rapid and easy erection, once it has been fitted the system forms an unbroken joint-free surface. The panels and associated parts can be fabricated by simple, every-day techniques. Such insulation is particularly suitable for use where heat exchange occurs mainly by convection and radiation. Its resistance to corrosion by the widest variety of heat-exchange fluids is such that it can be used for all types of reactors presently under industrial development. Its low thermal conductivity [0.11 w/m deg. C under the operating conditions for the Bugey I reactor (40 bars CO_2 and 240°C)] means that very thin coatings of about 25 to 30 mm can be used for HTR and PWR versions of gas-cooled graphite-moderated reactors. In addition, it is very rugged, it can be used to clad complex shapes without difficulty and, depending on the actual design, it can easily be removed. Being mechanically flexible as well as rugged, it is particularly suitable for applications involving temperature and pressure cycles, and is capable of reliable service under such conditions. (auth)

44831 (ORNL-tr-1966d) A NOVEL SOLUTION: THE HOT-LINER PRESSURE VESSEL. Courbon, J.; Merot, J. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Paper EN-1/7 of ENEA Symposium on the Technology of Integrated Primary Circuits for Power Reactors, Paris, May 20–22, 1968. 10p. (CONF-680525–2). Dep. CFSTI.

A number of problems arise when it is proposed to apply the current technique for the thermal insulation of pressure vessels (direct insulation in contact with the heat exchange fluid) to reactor types that do not already make use of it. A new solution to most of these difficulties is put forward; it is the "hot-liner pressure vessel". The leaktight skin or liner is in direct contact with the hot fluid and in the first few tens of centimeters of the concrete ("hot concrete") the temperature falls to about 50°C, leaving the remainder of the concrete ("cold concrete") as the load-bearing structure. The structure of a hot-liner pressure vessel for a water-type reactor is described, and the advantages and limitations of this technique are discussed. The economic aspects are also considered. By developing a special cement, it has been possible to obtain a concrete with a mechanical strength that is little affected by temperature. This concrete has been tested (strength, speed of sound, thermal conductivity, and so on), and the results are given. (auth)

44832 (ORNL-tr-1966-e) RECOMMENDATIONS ON THE DESIGN OF PRESSURE VESSELS FROM THE NUCLEAR SAFETY STANDPOINT. Costes, D. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Paper EN-1/6 presented at ENEA Symposium on the Technology of Integrated Primary Circuits for Power Reactors, Paris, May 20–22, 1968. 11p. (CONF-680525–3). Dep. CFSTI.

Draft regulations in France relating to prestressed concrete pressure vessels for nuclear use and in particular for gas cooled graphite-moderated reactors are presented. The Regulations proper lay down the technical limits to be observed and the tests to be carried out, while the accompanying Explanatory Notes set out the types of structure covered and the purpose of the limit imposed together with the lines along which manufacturers are encouraged to improve techniques. However, in their present form they contain little in the way of specifications applicable to the large openings in pressure vessels of the integrated primary circuit type. Recommendations are presented. (auth)

44833 (NP–17556) ILLUSTRATIVE POWER REACTOR PROGRAMMES. (European Nuclear Energy Agency, Paris (France)). May 1968. 44p. Dep.

Revisions in the data presented in the 1966 report are described. Using these data, illustrations of the long-term effects which could result from the eventual application of nuclear reactor technology along broad alternative lines of growth over the next forty years are presented. The effects of uranium supply and demand on economic power reactor development are described. (D.C.C.)

44834 (PEL–175–E) REPORT ON THE INVESTIGATION INTO THE POSSIBLE INTRODUCTION OF NUCLEAR POWER IN THE REPUBLIC OF SOUTH AFRICA. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). May 1968. 76p. Dep.

An analysis of the economics and technical feasibility of constructing nuclear power plants in South Africa is presented. The applications of nuclear reactors for power supply and desalination are considered. Types of reactors, fuel supply, costs, environmental effects, and reactor efficiencies are discussed for an optimum nuclear development plan. (D.C.C.)

44835 (RT/FI–(66)–42–bis) ECONOMIC EVALUATION OF THE URANIUM–THORIUM CYCLE IN A CIRENE TYPE REACTOR. Cardosi, G.; Venditti, P. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 118p. Dep.

The optimum economic values for irradiation level, specific power of fuel rods, and moderator to fuel ratio are calculated with reference to a fog-type thorium-fueled reactor with 500 MW(e) and a PCUT-type integrated reprocessing and remote fabrication system. The economic optimization is limited to cost considerations for the fuel cycle and the heavy water. Also considered are thermo-hydrodynamic and mechanical limitations for geometry of the fuel element and lattice pitch. (D.C.C.)

44836 (TID–24631) GUIDE FOR THE ORGANIZATION AND CONTENTS OF SAFETY ANALYSIS REPORTS. . June 30, 1966. 64p. Dep. CFSTI.

An outline on preparation of Safety Analysis Reports is given. This is intended as a guide for satisfying the requirements of Paragraph 50.34 of 10 CFR Part 50 for preparation and submission of documents by potential AEC licensees for production or utilization facilities. Included are indications of information required on: introduction and summary, site, reactor, reactor coolant system, containment system, engineered safeguards, instrumentation and control, electrical systems, auxiliary and emergency systems, steam and power conversion system, radioactive wastes, conduct of operations, initial tests and operation, safety analyses, and technical specifications. (M.L.S.)

44837 (TRG-Report-1692) EXPERIENCE WITH AND POTENTIAL OF THE STEAM GENERATING HEAVY WATER MODERATED REACTOR IN THE U.K. Bainbridge, G. R. (United Kingdom Atomic Energy Authority, Risley (England). Reactor Group). 1968. 17p. Dep. CFSTI. UK 4s. 0d.

Special advantages of steam cooled heavy water reactors are discussed. A brief description is given of the Winfrith S.G.H.W.R. reactor core, and it is shown how various modifications have led to cost improvements in the design of a 300 MW(e) S.G.H.W.R. Further technological improvements which may be introduced in commercial stations are considered, and it is concluded that the S.G.H.W.R. system will be fully competitive. (UK)

44838 (UJV-1944) DYNAMICS OF THE HYDRAULIC SYSTEM AND OPTIMISATION OF THE CONTROL OVERFLOW AT THE TR-O REACTOR. NUMERICAL SOLUTION. Zikan, M.; Pfann, J.; Krejci, M. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Jan. 1968. 95p. (In Czech). Dep.

Evaluation of the dynamics of the hydraulic system with regard to its control quality and choice of optimum design parameters is presented. Experimental data and digital computer calculations for differential equations are also presented. (auth)

44839 (UNC-5195) PLATR BOILING WATER REACTOR CRITICALS: COMPARISON OF EXPERIMENTAL RESULTS WITH CALCULATIONS. Goldstein, L.; Buck, P.; Brooks, W.; Nakache, F.; Luoma, J. (United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center). Dec. 1, 1967. 62p.

The Pawling Lattice Test Rig was used to determine the infinite multiplication factor and local power distribution of sections of fuel elements similar to Dresden Unit I reload fuel. The void substitution technique was used to determine k_∞, and the local power distribution was measured within the test fuel element. Experimental k_∞ values and power distributions are compared with results of calculations performed with the aid of neutron slowing-down/thermalization codes, and also with Monte Carlo transport codes. The calculated values of k_∞ agree within 1 to 2% of the experimental values, and calculated local power distributions show an average deviation from experimental distributions of 3%, with a maximum deviation for any one fuel pin of less than 10%. (H.D.R.)

44840 (UNC-5221) PERFORMANCE EVALUATION OF HEAT EXCHANGERS FOR SODIUM-COOLED REACTORS. Quarterly Technical Progress Report, April 1–June 30, 1968. Israel, S. L.; Nolan, D. J.; Malmborg, F. B. (United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center). July 20, 1968. Contract AT(11-1)-1452. 31p. Dep. CFSTI.

The ALCO Products, Inc. methods for predicting stresses due to thermal transients are reviewed. The expected largest rates of temperature change are calculated for typical strain gage locations. The effect of these rates on strain gage response is estimated. The rates are sufficiently low to permit the use of steady-state calibration data in interpreting strain gage output during transients. Sodium flow through vent lines and through the annuli between thermal shields and shells is now thought to be the major contributor to the unexpected temperature distributions in the lower tubesheet areas of both units. Recommendations are made to improve the accuracy of pressure drop measurements. Several strain gage locations were changed because of interference with equipment supports. Rosette configurations at each location and procedures for eliminating calibration shifts resulting from transfer of gages from calibration test bars to the heat exchangers are under review. Further reduction of Liquid Metal Engineering Center data from the intermediate heat exchanger vibration tests confirms that there is metal-to-metal impacting at sodium flow rates for which UNC calculations had predicted resonance in the sine-wave section of the tube bundle. (auth)

44841 (WASH-1082) CURRENT STATUS AND FUTURE TECHNICAL AND ECONOMIC POTENTIAL OF LIGHT WATER REACTORS. (Jackson and Moreland, Boston, Mass. Stoller (S. M.) Associates, New York). Mar. 1968. 402p. Dep. CFSTI.

REACTORS, POWER—economic and technical status and potential of light water, summary of; utility commitments for light water, tabular summary as of October, 1967; construction and operation costs for light water, tabular summary as of March 1, 1967; core parameters for light water, effects on costs of; pressure vessels for light water, effects on total cost of; siting of, summary of general AEC practices for; siting of, summary of general trends toward metropolitan; engineered safeguards for, effects on siting of; fuel performance for light water, summaries of; fuel elements for BWR and PWR, design parameters for; bibliography on light water

REACTORS, WATER-COOLED—economic and technical status and potential of light water, summary of; economic and technical potential of light water, summary of; construction and operation costs for power, tabular summary as of March 1, 1967; core parameters for power, effects on costs of; pressure vessels for power, effects on total cost of; fuel elements for, design parameters for; bibliography on power

PRESSURE VESSELS—effects on costs of nuclear power production; design of light water power reactor, development of

REACTORS, BOILING—fuel elements for, reference design parameters for; power peaking factors for, tabular summary of; fuel element performance in, tabular summary of; core lifetime for, effects of physics parameter uncertainties on; design parameters for nominal 515, 762, and 1075 MWe; systems for, detailed descriptions of; bibliography on power

REACTORS, PRESSURIZED-WATER—fuel elements for, reference design parameters for; power peaking factors for, tabular summary of; fuel element performance in, tabular summary of; core lifetime for, effects of physics parameter uncertainties on; design parameters for 500, 750, and 1000 MWe; systems for, detailed description of; bibliography on power

REACTOR FUELS—enrichment of uranium for power, economics of; reprocessing times for light water power; refining and conversion of light water power, projected costs for uranium; fabrication of light water power, costs of; cost factors for plutonium

REACTOR FUEL ELEMENTS—design parameters for BWR and PWR, reference

PLUTONIUM—recovery from irradiated fuels, projected costs of

REACTOR SAFETY—research programs on light water power, description of

BIBLIOGRAPHIES—on light water power reactors 105 references (M.L.S.)

44842 (WCAP-3680-7) CONTROL OF XENON INSTABILITIES IN LARGE PWR'S. Quarterly Progress Report for the Period Ending June 30, 1968. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). July 1968. Contract AT(30-1)-3680. 23p. (EURAEC-2045). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

The azimuthal Xe instabilities in large pressurized-water reactors of two different core geometries are considered using two-dimensional analysis. A comparison is made between the half-core model with symmetry about a principal axis and a half-core model of the same core with diagonal symmetry. In performing digital simulation calculations in three dimensions for Xe stability studies, a technique for pointwise flux-level extrapolation in time appropriate to diffusion theory calculations is developed. The numerical solution of the neutron diffusion equation to account for Xe feedback errors is presented. (D.C.C.)

44843 SOME ASPECTS OF NUCLEAR POWER ECONOMICS IN THE UNITED KINGDOM. Webb, M. G. Scott. J. Polit. Econ., 15: 22-42(Feb. 1968).

The First United Kingdom Nuclear Power Programme and the reasons for the inaccurate cost estimates made are described. The cost incurred by the late commissioning or below estimated availability of the nuclear stations are discussed, costs which may be important but which are generally omitted from published generating costs estimates. The validity of costing assumptions of the First Nuclear Power Programme of a 20-year station life and a station lifetime load factor of 75% is analyzed. Some of the achievements of nuclear electricity economics in the last decade are presented. (UK)

44844 NUCLEAR REACTOR FUEL ELEMENT INCLUDING A THERMIONIC CONVERTER DIODE. (to Siemens-Schuckertwerke Aktiegesellschaft). British Patent 1,124,135. Aug. 21, 1968. Priority date Nov. 26, 1964, Germany.

The fuel element described consists of a number of thermionic converter diodes connected in series built around the fuel material. Space is provided between the fuel material and the emitter electrodes to allow for expansion of the fuel during operation. This prevents distortion of the emitter surfaces that might cause short-circuiting of the converter diode. (H.D.R.)

44845 JET PUMP. Clabaugh, William J. (to United States Atomic Energy Commission). U. S. Patent 3,395,647. Aug. 6, 1968.

A jet pump for a boiling water nuclear fission reactor which incorporates a movable jet nozzle is described. The jet pump is constructed such that the nozzle is readily removable for replacement during reactor operation. In addition the jet pump is provided with means for preventing fluid back flow from the reactor when the normal fluid supply is shut off. (AEC)

44846 COMMISSIONING AND OPERATING EXPERIENCE WITH THE WINFRITH SGHWR. Smith, D.; English, D.; McCrikard, J. (Atomic Energy Establishment, Winfrith, Eng.). Atom, No. 141, 185-201(July 1968).

A review of the commissioning program for the SGHWR is presented. The loading and operating experiences to April 1968 are described. Core performance measurements are compared with predicted values. (D.C.C.)

44847 STEAM-COOLING TYPE REACTOR. Nakanishi, Tetsuichiro (to Hitachi Shipbuilding and Engineering Co., Ltd.). Japanese Patent 1968-871. Jan. 12, 1968. Filed Aug. 19, 1964.

In the steam-cooling type reactor proposed, superheated steam of improved quality can be generated in a simple and economic manner while retaining the nuclear safety intrinsic in a light-water moderated reactor. The degree of superheating in the reactor is decreased by bringing superheated steam in contact with water within the steam-producing pressure vessel. Saturated steam is produced by this means. It is then superheated by contact with the nuclear fuel. Part of the superheated steam is sent to a turbine. Also included are means to heat steam by nuclear fuel, a path to conduct heated steam, the first path to introduce steam into this inlet, the second path below the level of water to connect the outlet to a superheating-decrease means, the third path to conduct superheated steam to a steam consuming means, and, the fourth path to connect the exit of the superheating-decrease means to the first path. The water with regard to the paths and surroundings is used both as moderator and reflector. A path returns water heated by a superheating-decrease means in the first path to the reactor core together with the feed water, and a reactivity-control means uses a pump device. The reactor includes a means to heat steam by nuclear fuel, the first path to conduct heated steam, the second path to connect this outlet to a superheating-decrease means, the third path to conduct superheated steam to a steam consuming means, the fourth path to connect the outlet of a superheating-decrease means to the first path. An electrical heating device is provided in the steam generator for the adjustment of reactor start-up, temperature, etc. By utilizing the natural circulation of steam, the use of pumping power is eliminated. (NSA of Japan)

44848 METHOD FOR PRODUCING FUEL RODS FOR A GAS-COOLED POWER REACTOR. Nishimura, Keizo (to Furukawa Electric Co., Ltd.). Japanese Patent 1968-877. Jan. 12, 1968. Filed July 10, 1964.

By the method proposed, high-efficiency fuel rods for a gas-cooled reactor can be produced simply and in mass production. The fuel rod, which consists of a central heat-resistant bar and the surrounding fuel layer, is made by the casting of molten metallic fuel with the bar inserted into the "hole" mold; a plate with holes is attached to the top end of the bar for introducing molten metal into the space around the bar. The molten metal is poured and cooled. After cooling, both ends of the casting are cut off to produce the fuel rod. (NSA of Japan)

44849 NUCLEAR SAFETY. Volume 9, Number 5. Cottrell, Wm. B.; Jordan, W. H.; Blakely, J. P.; Savolainen, A. W. (eds.). One of Four Technical Progress Reviews Published for the Division of Technical Information, USAEC. Oak Ridge, Tenn., Oak Ridge National Lab., Sept.-Oct. 1968. 108p. GPO $0.60.

Separate abstracts are prepared for the ten separate sections. Information is included on reactor safety and chemical and biological aspects of nuclear safety. (M.L.S.)

For abstracts of individual sections see: 42830, 42874, 43322, 44850–44855, and 44909.

44850 BURNOUT IN BOILING HEAT TRANSFER. PART I. POOL-BOILING SYSTEMS. Gambill, W. R. Nucl. Safety, 9: 351-62(Sept.-Oct. 1968).

Selected recent developments regarding boiling burnout in saturated and subcooled pool systems are reviewed. Results are summarized for water, organic liquids, aqueous–organic mixtures, liquid metals (Na), cryogens (O_2, N_2, H_2, and He), overheating induced by flooding, experimental detection of nucleate boiling and incipient burnout, acceleration effects, transient boiling (exponential periods of 0.7 to 50 msec), and the effect of artificially restricted fluid circulation near the heater surface. Studies related to the dependence of critical heat flux on heater dimensions and orientation are considered in some detail. (70 references). (auth)

44851 WAIVING DEFENSES: A NEW APPROACH TO PROTECTING THE PUBLIC AGAINST FINANCIAL LOSS FROM USE OF ATOMIC ENERGY. Trosten, Leonard M.; England, William T. Nucl. Safety, 9: 343-50(Sept.-Oct. 1968).

The Price–Anderson Act, which provides a means for indemnifying nuclear facilities through a combined program of private insurance and government indemnity is discussed. The Act thereby protects the public and AEC licensees and contractors from the presently uninsurable potential liabilities associated with certain uses of atomic energy. Originally passed in 1957, the Act was amended in 1966 to provide greater assurance that moneys would be readily available to victims of a serious nuclear incident by authorizing the AEC to require participants to waive certain legal defenses that could present obstacles to claimants. (12 references). (auth)

44852 STANDARDS AND REACTOR SAFETY. Shaw, Milton (Atomic Energy Commission, Washington, D. C.). Nucl. Safety, 9: 337-42(Sept.-Oct. 1968).

Standards programs play an essential role in achieving and assessing reactor safety. The knowledge that a reactor is designed, built, tested, operated, and maintained to meet requirements mutually delineated by customer and vendor can best be established through the use of appropriate, accepted engineering standards. This knowledge provides assurance of safety margins and a basis for meaningful safety assessment. Nuclear industry use of accepted standards is needed to enable users and vendors inexperienced in this new technology to undertake complex power-reactor activities with an acceptable degree of success and safety. The Commission has recognized the need for standards in connection with its reactor development program and has undertaken a broad standards effort to ensure the safety and maximum availability of its experimental projects. (auth)

44853 GENERAL ADMINISTRATIVE ACTIVITIES. Blakely, J. P. Nucl. Safety, 9: 430-1(Sept.-Oct. 1968).

Modifications of the British policy toward the siting of nuclear power plants nearer metropolitan districts are discussed. Comments and proposals by the UKAEA's F. R. Farmer are included. (M.L.S.)

44854 ACTION ON REACTOR AND OTHER PROJECTS UNDERGOING REGULATORY REVIEW OR CONSIDERATION. Blakely, J. P. Nucl. Safety, 9: 432-40(Sept.-Oct. 1968).

A summary of AEC regulatory actions is given. Power reactors undergoing review are: Bell (Docket 50-319), Browns Ferry, Unit 3 (Docket 50-296), Crystal River, Unit 3 (Docket 50-302), Fort St. Vrain, Unit 1 (Docket 50-267), Edwin I. Hatch, Unit 1 (Docket 50-321), Kewannee (Docket 50-305), Oyster Creek, Units 1 and 2 (Dockets 50-219 and 50-320), Pilgrim, (Docket 50-293), Point Beach, Unit 2 (Docket 50-301), Shoreham, (Docket 50-322), Surry, Units 1 and 2 (Dockets 50-280 and 50-281), Three Mile Island (Docket 50-289), and Turkey Point, Units 3 and 4 (Dockets 50-250 and 50-251). (M.L.S.)

44855 PROGRESS SUMMARY OF NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROJECTS. Savolainen, A. W.; Whetsel, H. B. Nucl. Safety, 9: 407-29(Sept.-Oct. 1968).

Brief accounts are given of nuclear safety research on the following topics: water reactor safety–reactor kinetics and related studies; integrity of primary systems; loss of coolant and containment response; fission product behavior under accident conditions; safety test experiment program (LOFT); in-plant testing; criteria, codes, standards, and specifications; fast reactor safety; gas-cooled reactor safety; effluent control research and development program: environmental studies, waste treatment and disposal program. Outlines of the reactor operators study, Nuclear Safety Information Center operation, and heavy section steel technology program are given. (M.L.S.)

44856 THE EFFECT OF RADIAL TEMPERATURE GRADIENT ON THE FORMATION OF AXIAL VOID IN UO_2 FUEL ELEMENTS. Jedruch, Jacek (Pennsylvania State Univ., University Park). Int. J. Heat Mass Transfer, 11: 1155-65(July 1968).

The process of axial cavity formation in UO_2 nuclear fuel rods was investigated by means of a nodal model of heat transfer incorporating a space dependent heat source and both temperature and irradiation dependent thermal conductivity. The radii of the cavity and of the reorganized crystal zone were reproduced through calculation by postulating a progressive recrystallization of the initially porous UO_2, commencing at 1700°C, and associated with differential sublimation and condensation of UO_2 within the microscopic pores under the action of a high temperature gradient. The calculational model was found sufficient to predict quantitatively the experimentally observed changes in UO_2 rods, and leads to the conclusion that the axial cavity may form before the UO_2 melting temperature of 2876°C is reached at the center of the rod. (auth)

44857 CORROSION OF A VENTED STAINLESS-STEEL TUBE EXPOSED TO CO_2 CONTAINING 1 PERCENT CO IN A NUCLEAR REACTOR. Cribb, R. J. P.; Sumerling, R.; Dobing, E. (United Kingdom Atomic Energy Authority, Windscale, Eng.). Brit. Corros. J., 3: 176-81(July 1968).

A thin-walled 18Cr/10Ni/Ti stabilized austenitic steel tube was exposed to CO_2 containing 1 vol. % CO and 0.1 vol. % CH_4 and 80 to 90 ppm H_2O at 20 atm (285 psig) and 600 to 610° for 1000 hours in the Windscale Advanced Gas Cooled Reactor. The external surface of the tube over which the gas flowed remained in good condition, but in the bore, where the gas was effectively static, gross oxidation and carburisation occurred. Microscopic examination and thermodynamic considerations led to the conclusion that static gas conditions favored the attack observed in the bore, but poor surface finish may have initiated it. (auth)

44858 COMPARATIVE ECONOMIC EVALUATION OF A 300 MW(th) ORGANIC MODERATED AND COOLED REACTOR (OF THE ROVI TYPE) FOR SEA WATER DESALINATION. Guerrini, Bruno; Mazzini, Marino. Ing. Nucl., 9: 17-32(Jan.-Feb. 1968). (In Italian).

Principal design characteristics of a ROVI-type 300 MW reactor are listed; characteristics are categorized according to: general, core, control rods, moderator, volumetric fraction of material in the core, nuclear, and thermal and hydraulic. Design parameters for the steam generator, circulation pumps and emergency heat exchangers are tabulated. Schematics of the primary and emergency cooling circuits are shown. An economic evaluation, from the points of capital investment, personnel, operation, and maintenance, is presented; results are tabulated as a function of power output. (M.L.S.)

44859 BRITISH NUCLEAR POWER PLANT. [London], British Nuclear Export Executive, 1968. 44p.

Topics discussed include: progress in the exploitation of the gas-cooled reactor; performance of the Central Electricity Generating Board nuclear power stations; design, commissioning and operation of the steam generating heavy water reactor; place of the fast reactor in commercial power development; nuclear fuel supplies and services of the United Kingdom Atomic Energy Authority. (UK)

44860 FUEL ASSEMBLY PERFORMANCE IN PIQUA CORE I. Miller, K. J.; McCurnin, W. R. (Atomics International, Canoga Park, Calif.). Nucl. Appl., 5: 123-9(Sept. 1968).

Detailed post-irradiation examinations were performed on six fuel assemblies from Piqua Core I. The assemblies were examined for mechanical integrity, organic coolant deposition (primarily in the heat transfer regions), and fuel burnup capability. Fuel cylinder dimensional measurements indicated that the assemblies could reach their design average burnup of 3000 MWd per metric ton of uranium. (auth)

44861 PASSIVE SAFETY-DEVICE AGAINST A MELT-THROUGH ACCIDENT. Zivi, S. M. (Thompson Ramo Wooldridge Inc., Redondo Beach, Calif.). Nucl. Appl., 5: 53-4(Aug. 1968).

In a loss-of-coolant accident in which gross melting of the core is not prevented, a melt-through of the bottom of the containment vessel may be averted by an unenriched UO_2 barrier beneath the reactor vessel. Such a barrier would melt only very slowly because the fuel mass from the core would tend to float on top of the barrier, and the melting front in the barrier could advance only as a result of heat conducted through the previously melted part of the barrier. This gives rise to a melting front advance which varies as $mt^{1/2}$, where m is a constant determined by the material properties. A calculation indicates that the rate of penetration of the melting front is more than an order of magnitude less if the core mass floats on the barrier, than if the core mass is more dense than the barrier, and tends to displace it and sink to the melting interface. (auth)

44862 FIRST NUCLEAR DESALINATION PLANT. Int. At. Energy Agency Bull., 10: No. 3, 11-13(1968).

A description of the BN-350 dual-purpose nuclear reactor at Shevchenko is presented. The reactor will product 1.5×10^6 tons of fresh water daily and generate 150 MW(e). (D.C.C.)

44863 PERFORMANCE OF GAS-COOLED FAST REACTORS WITH ARTIFICALLY ROUGHENED FUEL ELEMENTS. Melese-d'Hospital, Gilbert (Gulf General Atomic Inc., San Diego, Calif.). Nucl. Sci. Eng., 33: 271-83(Sept. 1968).

For given maximum surface and internal fuel temperatures and coolant inlet temperature, the optimum degree of artificial roughening of the surface of gas-cooled fast reactor fuel elements is such that the Stanton number is approximately doubled with respect to smooth rods. For given coolant temperatures and maximum clad temperature, the power per unit length of rod increases approximately linearly with increasing Stanton number. Core performance is not sensitive to possible uncertainties in friction factor (±25%), slight decrease in surface heat transfer, or to the fraction of the active rod which is roughened. By proper design, fuel cycle costs remain low (0.5 to 0.6 mil/kWh) for a substantial range of values of maximum clad temperature (600 to 700°C), maximum linear rating (12 to 18 kW/ft), and degree of surface roughening (1.5 to 2.5) with helium cooling of oxide rods. (auth)

44864 BLANKET OPTIMIZATION AS AN EXAMPLE FOR A STEAM-COOLED FAST BREEDER REACTOR. Mayer, L. (Kernforschungszentrum, Karlsruhe, Ger.). Nukleonik, 11: 193-201(July 1968). (In German).

The basis of blanket optimization is burn-up calculations with few energy groups. Therefore the effects of collapsing the 26-group-ABN-set into a few groups have first been considered. Radial and axial blanket design and management have then been optimized taking into account physical and economical aspects. Though the calculations have been performed for a steam cooled fast breeder of 1,000 MWe, many of the results are valid for other types of fast breeders as well. (auth)

44865 METHOD OF TEMPERATURE NON-UNIFORMITY CALCULATION IN FUEL ELEMENT BUNDLES COOLED WITH LIQUID METALS. Ibragimov, M. Kh.; Zhukov, A. V. At. Energ. (USSR), 24: 520-3(June 1968). (In Russian).

Temperature distribution calculated in fuel element bundles cooled with "plane" coolant flow (coolant velocity is constant along the duct and turbulent heat transfer is absent). By comparing the calculated and the experimental data the correlation function is derived that takes into account temperature changes with Re number. The method of determining the temperature non-uniformities of different construction cylindrical fuel elements is developed. (8 references) (auth)

44866 CALCULATION OF FUEL BURNUP IN HEAVY WATER REACTORS. Kujal, Bohumir; Kujal, Josef (Inst. of Nuclear Research, Rez, Czech.). Jad. Energ., 14: 125-30(Apr. 1968). (In Czech).

Equations are given for calculating local burnup in nuclear reactor fuel. Terms are included for fissile material and fission product concentrations and for thermal and epithermal neutron absorption. Radial differences in ^{235}U and ^{239}Pu are considered. Graphs are presented for reactor physical parameters as a function of burnup and fission product concentrations for several types of fuel. Gas and organic cooling are considered, as is excess reactivity. The method is accurate for burnups to 10,000 MWd/(t). (TTT)

44867 SHUTDOWN-CRITERIA OF REACTOR SAFETY SYSTEM FOR PROTECTION FROM EXCESSIVE TEMPERATURES. Uhrig, Hans (Kernforschungszentrum, Karlsruhe, Ger.). Nukleonik, 11: 117-26(June 1968). (In German).

The primary task of a reactor safety system is to protect the reactor core from excessive temperatures. To do this it can trip the reactor. The shutdown of the reactor is triggered by the trip signal, which is generated out of measuring signals via shutdown criteria. A special set of such criteria and a procedure of calculating the trip settings are given. Great emphasis is placed on complete protection by the criteria and in spite of this on the allowance of a high stationary reactor power. (9 references) (auth)

Marine and Portable Power Reactors

44868 (DOCKET-50238-1) N.S. SAVANNAH SAFETY ASSESSMENT. VOLUME I. ENGINEERING AND CONSTRUCTION. (Babcock and Wilcox Co., Lynchburg, Va. Atomic Energy Div.). Aug. 1960. 270p. (TID-17885(Vol.1)). Dep. CFSTI.

Engineering and construction aspects of the N. S. *Savannah* are detailed. Design information is included on: the ship, power plant reactor system, propulsion system, ship's service systems, and refueling and radioactive waste management. (M.L.S.)

44869 (DOCKET-50238-2) N.S. SAVANNAH SAFETY ASSESSMENT. VOLUME II. OPERATIONS. (States Marine Lines, Inc., [New York]). Aug. 1961. 199p. (TID-17885(Vol.2)). Dep. CFSTI.

Information on the operation of N. S. *Savannah* is given. Topics discussed are: operating policies; manning of N. S. *Savannah*; nuclear shore staffs; power plant description; tests and trials; standard operations; refueling, maintenance and repair facilities; refueling; and maintenance and repair. (M.L.S.)

44870 (DOCKET-50238-3) N.S. SAVANNAH SAFETY ASSESSMENT. VOLUME III. RADIOLOGICAL HEALTH. (States Marine Lines, Inc., [New York]). Aug. 1961. 232p. (TID-17885(Vol.3)). Dep. CFSTI.

Information on the N. S. Savannah is given under the following subjects: radiation production criteria; shielding; the N. S. Savannah health physics program; waste management; emergency considerations and procedures; and environmental support activities. (M.L.S.)

44871 (DOCKET-50238-4) N.S. SAVANNAH SAFETY ASSESSMENT. VOLUME IV. ANALYSES OF HYPOTHETICAL ACCIDENTS. (Babcock and Wilcox Co., Lynchburg, Va. Atomic Energy Div.). Nov. 1960. 256p. (TID-17885(Vol.4)). Dep. CFSTI.

Analyses of hypothetical accidents on the N. S. Savannah are given. Analyses include: reactivity accidents, mechanical failures, fire within the containment vessel, failure of the waste management system, and ship accidents. (M.L.S.)

44872 OSNOVY TEPLOVYKH I GIDRAVLICHESKIKH RASCHETOV SUDOVYKH YADERNYKH REAKTOROV I PAROGENERATOROV. (Basis of Thermal and Hydraulic Calculations of Marine Nuclear Reactors and Steam Generators). Terent'ev, V. D. Leningrad, Izdatel'stvo Sudostroenie, 1967. 208p.

Thermal and hydraulic calculations of marine nuclear reactors and steam generators are discussed and general and specific relations for these heat exchange devices are given. An attempt was made to correlate the aspects of thermal and hydraulic processes in reactors and in steam generators. Steam separation and combined nuclear reactor and steam generator operations in steady-state transient conditions are discussed. 99 references. (R.V.J.)

Rocket and Space Reactors

44873 (LA-DC-9484) TESTING HEPA FILTERS FOR USE IN A HIGH NOISE LEVEL ENVIRONMENT. DeField, James D. (Los Alamos Scientific Lab., N. Mex.). [1968]. Contract W-7405-eng-36. 14p. (CONF-680811-5). Dep. CFSTI.

From Symposium on Operating and Developmental Experience in the Treatment of Airborne Radioactive Wastes, New York.

During the pulsed cooling phase of nuclear reactor rocket engine tests, as part of the Rover Program at Los Alamos Scientific Laboratory, the possibility of atmospheric release of radioactive particulates exists. To control this potential release, a special air cleaning system employing High Efficiency Particulate Aerosol (HEPA) filters was designed, constructed, and tested. A primary concern was the structural integrity of these filters under the intense noise levels that exist during reactor tests. Commercially available HEPA filters were subjected to noise levels simulating the acoustic environment that exists near a reactor during testing. These acoustic exposures included both reverberant and progressive fields of varying time intervals and reached maximum sound pressure levels of 148 db. Filter efficiency tests using air-generated dioctyl phthalate (DOP) were performed before and after acoustic exposures and are reported. Details of the acoustic and DOP test methods are also discussed. (auth)

44874 (NASA-CR-72329) CAVITY REACTOR GAS-CORE CRITICAL EXPERIMENT. Kunze, J. F.; Masson, L. S.; Pincock, G. D.; Wood, R. E.; Hyland, R. E. (General Electric Co., Idaho Falls, Idaho. Nuclear Materials and Propulsion Operation). Nov. 6, 1967. Contract C-67747-A. 21p. (CONF-671102-42).

From 15th Conference on Remote Systems Technology and Atom Fair, Chicago, Ill.

A gaseous UF$_6$ core configuration was made critical in a 4 foot diameter, 43 inch long, tank and critical loading measurements were made. The results from the real gas configuration are compared with those from a mockup U-foil configuration of the same dimensions. It is concluded that the mockup provides an adequate representation of the gas core and can be used to simplify studies of variations in materials and geometry for the cavity reactor concept. (H.D.R.)

44875 (TID-3586) NUCLEAR ROCKETS. A Bibliography, 1966-1967. Voress, Hugh E. (comp.) (Division of Technical Information (AEC), Washington, D. C.). Aug. 1968. 45p. Dep. CFSTI.

A total of 235 references to literature appearing in Nuclear Science Abstracts for 1966 to 67 is presented. Author and report-number indexes are provided. (auth)

44876 (UCRL-50004-68-1(Pt.1)) ADVANCED SPACE NUCLEAR POWER PROGRAM. Quarterly Report, January-March 1968. (California Univ., Livermore. Lawrence Radiation Lab.). Contract W-7405-eng-48. 48p. Dep. CFSTI.

Fabrication of Re-W tubing by chemical vapor deposition is described. Welding methods for Mo-Re-W alloys are tested. Fabrication of UN sintered powders is described. Physical properties of liquid lithium are presented. A description of the SPR-4 reference design is presented. (D.C.C.)

44877 OPEN-CYCLE AND LIGHT-BULB TYPES OF VORTEX-STABILIZED GASEOUS NUCLEAR ROCKETS. Clark, James W.; Johnson, Bruce V.; Kendall, John S.; Mensing, Arthur E.; Travers, Arthur (United Aircraft Research Labs., East Hartford, Conn.). Contract NASw-847. J. Spacecraft Rockets, 5: 941-7(Aug. 1968).

An extensive investigation of vortex flows is conducted to obtain information for evaluating two vortex-stabilized gaseous nuclear rocket engine concepts, the open-cycle engine and the nuclear-light-bulb engine. Both concepts are based on the transfer of energy by thermal radiation from gaseous nuclear fuel contained in a vortex to seeded hydrogen propellant. Heavy-gas containment tests are conducted using gases having different molecular weights to simulate gaseous nuclear fuel and either propellant in the open-cycle concept or a neon buffer in the nuclear-light-bulb concept. Flow visualization tests are conducted in water vortexes to obtain fundamental information on flow patterns. Based on these results and on the results of concurrent engine design and performance studies, it is concluded that the fuel loss rate in a vortex-stabilized open-cycle engine would be an order of magnitude too large for economical engine operation. However, experiments indicate that radial-inflow vortexes provide flow patterns that are suitable for the nuclear-light-bulb engine, and it is recommended that further fluid mechanics research be directed toward this concept. 29 references. (auth)

44878 POTENTIAL APPLICATIONS AND PROBLEMS OF DEVELOPMENT OF NUCLEAR ROCKETS. Venchiarutti, Radames (CNEN, Rome). Missili Spazio, 9: 103-16(June-Aug. 1967). (In Italian).

The potential applications and problems relative to the research and development of nuclear energy for rocket propulsion systems are examined. The use of nuclear reactors and radioisotopes as heat sources is discussed. Both solid-core and advanced-core concepts are described. The radioisotopes considered for space-power supplies are tabulated. 14 references. (M.L.S.)

Process Heat and Desalination Reactors

Refer also to abstract 42937.

44879 (EUR-4034) WATER DESALINATION ECONOMICS IN NORTHERN EUROPE BASED ON WATER REACTORS. (Atlas Werke G.m.b.H., Bremen (West Germany). Societe Belge pour l'Industrie Nucleaire, Brussels. Societe de Traction et d'Electricite, Brussels (Belgium)). Jan. 5, 1968. Contract 029-66-4-ECIC. 156p. Dep.

Water shortage in Western Europe occurs very seldom and in specific areas only. This position will continue to prevail quite generally in most locations. Water generation may be economically feasible only in specific districts such as those of the Northern coast of the Netherlands and Germany. On the other hand, the electricity demand will continue to increase much more quickly than the water demand and in this context dual purpose nuclear plants may meet both demands without unduly penalizing the kWh cost. The Northern Europe population density precludes the likelihood of other than large desalination plants on the mainland. Technologically and economically, the most suitable desalination process at present is the multiflash system. Such a plant can cope adequately with future demands. The water costs, in fact, fall within the range of prices acceptable in the European Community. The use of nuclear energy will be suitable in the large capacity range soon required in the fast developing region of the Northern part of the European Community, to cope with the corresponding demographic and industrial expansion. (auth)

44880 (NP-17508) APPLICATION OF NUCLEAR ENERGY TO SEA-WATER DESALINATION. (Motor-Columbus Electrical Management Co. Ltd., Baden (Switzerland)). Jan. 1967. 64p. Dep.

The present and future electrical power and potable water requirements of the Lima, Peru, area are examined. Technical and economic considerations in the application of dual purpose light water reactor plants to satisfy part of the anticipated requirements are discussed for units producing 100 MW(e) and

5 to 10 million gallons per day or 300 MW(e) and 15 to 30 million gallons per day. Various desalination processes are reviewed and compared. Water and power costs are tabulated for plants of the sizes mentioned utilizing the distillation process. It is concluded that only the 300 MW(e) plant would produce currently economic power, that the 300 MW(e) capacity exceeds present absorption capacity of the Lima utility, and that the resulting water cost is too high for general use. (H.D.R.)

44881 (ORNL–4291) NUCLEAR ENERGY CENTERS INDUSTRIAL AND AGRO-INDUSTRIAL COMPLEXES SUMMARY REPORT. (Oak Ridge National Lab., Tenn.). July 1968. Contract W-7405-eng-26. 30p. Dep. CFSTI.

A description of a feasible nuclear powered agro-industrial complex is presented. Economic justifications are provided for combinations of food crop types and production rates, chemical production and recovery, electric power generation, and water production by desalination. An optimized agro-industrial complex is described and a reference design is presented. (D.C.C.)

Research and Test Reactors and Critical Assemblies

Refer also to abstracts 42813, 43157, 43629, 43647, 44580, 44594, and 44839.

44882 (AECL–2779) LATTICE MEASUREMENTS WITH 19-ELEMENT RODS OF ThO_2–^{235}U O_2 IN HEAVY WATER MODERATOR. PART II. RELATIVE FISSION RATES, FAST FISSION RATIO, CONVERSION RATIO, AND COMPARISON WITH CALCULATIONS. Okazaki, Albert (Atomic Energy of Canada Ltd., Chalk River (Ontario)). June 1968. 41p. Dep. CFSTI. CAN $1.50.

Lattice parameter measurements of heavy water moderated lattices of 19-element clusters of ThO_2 containing 1.5 w/o UO_2 (93 a/o ^{235}U) are presented. Relative ^{233}U, ^{235}U and ^{239}Pu fission rates, fast fission ratio, and conversion ratio measurements are described. D_2O, air, H_2O and organic HB40 coolants were studied at 22 and 28 cm triangular lattice pitches. Additional analyses of the critical substitution measurements have been made and revised bucklings are given. Calculations made with the LATREP and HAMMER codes are compared with measured lattice parameters. Both codes underestimate the buckling by up to 1 m^{-2} with the largest discrepancy at the tightest lattice pitch. The calculations overestimate the neutron disadvantage factor and conversion ratio. (auth)

44883 (AECL–3143) FLUX PEAKING AND SUPPRESSION IN CANDU–BLW FUEL BUNDLES. Roshd, M. H. M. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). May 1968. 37p. Dep. CFSTI. CAN $1.00.

Experiments were performed in the ZED-2 reactor to determine the flux peaking in the fuel when two 18-element CANDU-BLW fuel bundles were in contact. Three coolants were used: H_2O, D_2O and air. The flux peaking at the end of a fuel bundle in contact with coolant only and the suppression of this peaking by using a stainless steel suppressor of a suitable size were also measured for H_2O and D_2O coolants. (auth)

44884 (ANL–7369) DEVELOPMENT OF PUMPS FOR USE IN FAST-REACTOR-SAFETY INTEGRAL-LOOP EXPERIMENTS. Robinson, L. E.; Carlson, R. D. (Argonne National Lab., Ill.). Apr. 1968. Contract W-31-109-eng-38. 14p. Dep. CFSTI.

The design of an annular linear-induction pump suitable for use in a radioactive environment is described. The pump is designed for an in-pile Na loop in which fast-reactor safety studies are to be conducted. The pump is capable of operating at 500°C and will deliver 10 gpm at 20 psi with an efficiency of 3%. At 200°C, the pump will deliver 20 gpm at 20 psi with an efficiency of 5%. The pump tube is capable of withstanding a static pressure of 340 atm. (auth)

44885 (BNWL-692) PCTR MEASUREMENT OF k_∞ FOR URANIUM–BISMUTH SUPERCELL. Vaughn, A. D. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 1, 1968. Contract AT(45-1)-1830. 48p. Dep. CFSTI.

A measurement is made of the neutronic parameters for a low absorption target in a supercell consisting of a three-to-two fuel-to-target ratio with separate tubes of uranium fuel and bismuth metal target. Each tube is water cooled and surrounded by a graphite moderator on an 8.0″ lattice pitch. The bismuth target elements are relatively larger (3.750″ O.D.) than the uranium fuel elements (1.508″ O.D.) in order to irradiate as much of the target material as possible because of the significantly low bismuth cross section. Four inch square hole bars are removed from each target cell to contain a round aluminum process tube with the target elements. The graphite hole bars for the fuel cells contained 2.0″ O.D. holes and zirconium process tubes. The experiment is conducted in the Physical Constants Testing Reactor (PCTR) for a zero exposure case at room temperature. The reactivity effect of coolant loss is included in these measurements. (auth)

44886 (CEA-R-3501(Pt.1)) RAPSODIE FIRST CORE MANUFACTURE. PART I. PROCESSING PLANT. Masselot, Yves; Bataller, Simone; Ganivet, Michel; Guillet, Henri; Robillard, Andre; Stosskopf, Francois (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). 1968. 124p. (In French). (EUR–3862).

The first in a series of three reports describing the processes, results and peculiar technical problems related to the manufacture of the first core of the fast reactor RAPSODIE is presented. A detailed study of manufacturing processes (pellets, pins, fissile sub-assemblies), the associated testings (raw materials, processed pellets and pins, sub-assemblies before delivery), manufacturing facilities, and improvements for a second campaign are described. (auth)

44887 (EURAEC–2003) CALCULATION OF SPECIFIC BURNUP IN A NUCLEAR FUEL PELLET IRRADIATED IN AN ORDINARY WATER REACTOR. Special Technical Report No. 1. Novario, P. G.; Vajra, J. (Societa Ricerche Impianti Nuclear, Saluggia (Italy)). Jan. 1968. 42p. (EUR–3794). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

The calculation procedure adopted to evaluate the specific burnup attainable in a natural or slightly enriched uranium or uranium oxide pellet, to be irradiated in a recess in the Avogadro RS-1 reactor, is described. The irradiation period is divided into consecutive partial periods, in each of which the neutron distribution and the composition are treated as constant as regards the reaction rate. The variations of the pellet composition with time are assumed to be due to variations in the concentrations of the nuclides ^{235}U, ^{238}U and ^{239}U only. The calculation is programmed for SORIN's Elea 6001 computer. (auth)

44888 (GEAP–5357) PLUTONIUM SUBCRITICAL EXPERIMENT PROGRAM. Final Report, October 31, 1967. Carver, J. G. (General Electric Co., Pleasanton, Calif. Nucleonics Lab.). Dec. 1967. Contract AT(04-3)-189. 139p. (EURAEC–1989). Dep. CFSTI.

Work Performed Under United States–Euratom Joint Research and Development Program.

A pressurized subcritical facility has been constructed with its main pressure vessel directly above a 28-inch (71 cm) diameter fission source plate centered on the top face of the General Electric Nuclear Test Reactor. Fuel lattices with water-to-fuel ratios of 2:1 and 3:1, having an effective multiplication of 0.97 at 70°F, were constructed from Zircaloy-2-clad mixed-oxide fuel rods containing pellets of 98.5% natural UO_2 and 1.5% PuO_2 (with a ^{240}Pu content of 16.33%), having an active fuel diameter of 0.491 inch (1.25 cm), and an active length of 24 inches (60.96 cm). With the Nuclear Test Reactor at full power (and the fission plate at less than 1 kW) thermal neutron fluxes in the centers of these lattices, at 70°F, were on the order of $6 \times 10^8/cm^2$-sec. These lattices were irradiated in the pressurized facility at a variety of temperatures and pressures up to 540°F and 1050 psig to determine nuclear reaction rates at various points within the unit cell of the lattice. Resonance activation measurements were made in the unit cell using Lu, Yb, ^{191}Ir, ^{193}Ir, Au, La, and Cu; and resonance ratios (e.g., Lu/Cu activity) were determined with precisions typically in the range of 1 to 2% (one standard deviation). Most of the activity induced in Lu, Yb, ^{191}Ir, and Au was caused by the principal resonance of the isotope for the range of neutron spectra represented in these fuel lattices. It proved possible to design and fabricate the resonance foils so that self-shielding and Doppler effects were negligible and so small that they introduced no significant perturbation to the local neutron spectrum, while maintaining sufficient resonance material to yield usable activity levels from 4-hour irradiations. Foils were irradiated in pure water to provide the data for "normalizing" these measurements so that predicted resonance ratios could be compared directly with experimental ratios on an absolute basis. Neutron spectra were computed with the THERMØS code up to 0.7849 eV; and from 0.7849 to 1.7 eV with a version of the EPITHERMØS code modified to account for upscattering of neutrons from the lower of these two energy ranges into the higher. This combination of codes accurately predicted the general magnitudes of the resonance ratios to within 30% except for Yb:Cu; temperature dependence of the ratios was predicted accurately in some cases, but was poorly predicted for Lu/Cu in the 3:1 lattice and for Yb/Cu in both lattices. Fission ratio measurements were made within the unit cell with small Zr-clad foils highly enriched in ^{235}U, ^{239}Pu, and ^{241}Pu with experimental precisions of 4 to 5% (one standard deviation). The THERMØS/modified-EPITHERMØS combination successfully predicted the fission rate observed in the 3:1 lattice to within 5%, but theory-experiment discrepancies in the 2:1 lattice ranged as high as 15%. Supporting investigations included the development of theory to guide the loading of the subcritical lattices by a poison-withdrawal, inverse-flux-plot method by using the spontaneous fissions in the fuel rods as the neutron source. Both measurements and detailed analysis confirmed the conclusion that neutron spectra in the centers of these lattices were essentially identical to the infinite-lattice spectra, and that these spectra persisted throughout a major central fraction of the core volume. (auth)

44889 (GEAP-5629) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR DEVELOPMENT PROGRAM. Quarterly Report No. 16, February-April 1968. Pflasterer, G. R. (comp.) (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). May 1968. Contract AT(04-3)-540. 32p. Dep. CFSTI.

An exposure history analysis of SEFOR guinea pig rods A01 to A15 is presented. Fabrication of a PuO_2-UO_2 hexagonal fuel channel and its components for SEFOR is described. A description of Re-W thermocouples used in SEFOR hexagonal fuel channel is presented. (D.C.C.)

44890 (IDO-17270) SPERT PROJECT. Quarterly Technical Report, April-June 1967. Taxelius, T. G. (ed.). (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). June 1968. Contract AT(10-1)-205. 46p. Dep. CFSTI.

The objective of the Spert III Oxide Core Kinetics Test program is to study reactor kinetic behavior under conditions typical of pressurized-water reactors. The core used is a slightly enriched, UO_2-fueled core, designated the E-core. Experimental data on the transient behavior of the reactor for step reactivity insertions up to 1.25$ with low initial reactor power and various initial system conditions are presented. Calculations of the kinetic behavior of the E-core are performed using the point reactor kinetics equations in the IREKIN and PARET computer codes. Analysis of fuel rod deformation is presented. Transient testing to establish the operational capability of the Spert IV Capsule Driver Core (CDC) is described. A hydraulically driven transient rod drive for the Power Burst Facility is described for providing the controlled reactivity insertion rates required for shaping the power burst. Computer models of the hydraulic drive, combined with a simulation of PBF reactor kinetics, are developed to predict the performance of the reactor during a burst-shaping operation. Performance tests on a prototype of the hydraulic drive verify the accuracy of the computer models. (auth)

44891 (IFA-FR-61) THERMAL NEUTRON SPECTRA BY THE POLYNOMIAL METHOD. Christian, I. (Academia R. P. R., Bucharest. Institutul de Fizica Atomica). 1968. 10p. Dep.

The thermal neutron spectrum in the graphite thermal column of the WWR-S reactor was measured by the activation method. An orthogonal polynomial expansion was used to provide an analytical expression of the spectrum on the basis of the activation data. (H.D.R.)

44892 (IFA-FR-62) NEUTRON TEMPERATURE IN THE GRAPHITE AND INTERNAL THERMAL COLUMNS OF THE VVR-S REACTOR. Girlea, I.; Stefan, H.; Fodor, G.; Cristian, I. (Academia R. P. R., Bucharest. Institutul de Fizica Atomica). 1968. 12p. Dep.

The effective temperature of thermal neutron spectra in the graphite and internal thermal columns of the WWR-S reactor was measured by the activation technique using Westcott's formalism. The foil preparation, experimental procedure, and results are presented. (H.D.R.)

44893 (IFA-FR-64) XENON PEAK LOWERING WITH A SINGLE POWER PULSE AT THE VVR-S REACTOR. Rosescu, Teodor (Academia R. P. R., Bucharest. Institutul de Fizica Atomica). 1968. 6p. Dep.

The optimal conditions of shutdown and operation of the VVR-S reactor for lowering the xenon poisoning peak are examined. Calculations were performed assuming the impossibility of a power pulse greater than nominal power and a total pulse duration time lower than 0.5 hours. The results show a single nominal pulse will lead to a slight lowering of the xenon peak and of the time when the equilibrium xenon value is reached. (H.D.R.)

44894 (IFA-FR-69) RESONANCE NEUTRON SPECTRUM OF REACTOR. Grancea, I.; Cuculeanu, V.; Fratiloiu, Gh. (Academia R. P. R., Bucharest. Institutul de Fizica Atomica). 1968. 10p. Dep.

The resonance neutron spectrum was measured in the WWR-S reactor by the activation of foil resonance detectors and the cadmium-ratio method. The results were used to determine the spectral index r from Westcott's formalism and investigate the deviation of the spectral distribution from the 1/E law. (H.D.R.)

44895 (IN-1067) ANALYSIS OF ARMF MEASUREMENTS BY ONE-DIMENSIONAL MULTIGROUP DIFFUSION CALCULATIONS. Millsap, D. A. (Idaho Nuclear Corp., Idaho Falls). July 1968. Contract AT(10-1)-1230. 56p. Dep. CFSTI.

Descriptions of the ARMF-I and ARMF-II core loadings for reactivity measurements are given. Experimental procedures are given. Calculational procedures are described; energy and lethargy group structures are listed. Normalized unperturbed real fluxes, adjoint fluxes, and absorption statistical weights are tabulated. Results of measured and calculated values are shown graphically. Group cross sections and reactivities are tabulated for water, heavy water, Be, C, Mg, Al, Zr, Pb, and Bi. 12 references. (M.L.S.)

44896 (NMI-4379) EVALUATION OF THREE ENRICHED HWCTR DRIVER TUBES FOR IRRADIATION AT SRP. Huntress, A. M.; Kaufman, D. F. (Nuclear Metals, Inc., West Concord, Mass.). Apr. 26, 1960. Contract AT(30-1)-1565. 37p. Dep. CFSTI.

The evaluation of three enriched Zircaloy-2-clad uranium-zirconium driver tubes, No. 58, 59, and 60, is presented. (auth)

44897 (ORNL-TM-2221) NEUTRON FLUX AND NEUTRON AND GAMMA-RAY SPECTRA MEASUREMENTS AT THE HFIR. Blosser, T. V.; Thomas, G. E. Jr. (Oak Ridge National Lab., Tenn.). June 24, 1968. Contract W-7405-eng-26. 31p. Dep. CFSTI.

Preliminary neutron flux and neutron and gamma-ray spectra measurements were made at the exit of the High Flux Isotope Reactor (HFIR) beam tubes HB-2 (radial beam tube) and HB-3 (tangential beam tube) to determine the effect of the location of the beam tube on the emerging radiation. A comparison of the neutron flux at various energies showed a variation between HB-2 and HB-3 of from about 11% at thermal energies to a factor of 10.2 at 6.3 MeV. There is a marked difference between the gamma-ray spectrum that each beam tube exhibits. (12 references) (auth)

44898 (SGAE-PH-67/1968) UHV-SYSTEM FOR A REACTOR BEAM TUBE. Baltacis, E.; Dobrozemsky, R.; Kubischta, W. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Physik-Institut). [1967]. Contract 61(052)-857. 15p. (CONF-680401-5). Dep. CFSTI.

From 4th General Meeting on International Organization for Vacuum Science and Technology, Manchester, England.

For an experiment on free neutron decay the energy spectrum of the decay protons which have energies of a few hundred eV are measured. The decay protons originate near the reactor core in a tangential beam tube. The spectrometer and detector are placed 4 meters from the reactor core outside the reactor shield. To reduce interactions with the gas atoms, which result in an energy-dependent transmission of the protons, a bakeable all-metal system is necessary. The baking temperature is limited by the presence of magnetic shielding material and by reactor safety considerations to about 100°C. In the central parts of the beam tube the outgassing rates are increased by the presence of γ and neutron radiation (dose rate about 10^8 rad/h). Since the conductance between this source of gas and the pump is only a few litres/sec it is necessary to investigate the reactor outgassing effect. The outgassing properties of Al under reactor irradiation after moderate bakeout procedures are discussed. The outgassing data are obtained by the throughput method. A heavy increase of outgassing rates is recorded and found to be caused mainly by γ radiation. (auth)

44899 (TID-24579) MEASUREMENT OF THE ZERO POWER TRANSFER FUNCTION OF THE KANSAS STATE UNIVERSITY TRIGA MARK II NUCLEAR REACTOR. Beeson, Charles Lee (Kansas State Univ., Manhattan. Dept. of Nuclear Engineering). 1966. 130p. Dep. CFSTI.

A linear motion pile oscillator is designed and built. The oscillator is then used for zero power frequency response measurements on the Kansas State University TRIGA Mark II reactor. The frequency range investigated is 0.01 cps to 40.0 cps. Two methods of data reduction are used to determine the reactor gain and phase shift. One method uses a dual-channel strip chart recorder. The reactor input and output signals are recorded on separate channels, and the desired gain and phase shift information obtained by direct visual measurement. The second method involves the use of an analog computer to integrate the absolute value of the reactor input and output signals, and their product. Using the three voltages thus determined, and the appropriate expressions, the gain and phase shift are calculated. Both data reduction methods are found satisfactory for transfer function gain measurements, the analog computer method being the simpler and more rapid of the two. Neither method is found to be well suited to accurate measurement of the phase shift. Digital computer codes are developed to perform a least squares fitting of the the theoretical gain and phase shift expressions to the measured data. This fitting procedure is used for determining the ratio, α, of the effective fraction of delayed neutrons, β, to the prompt neutron lifetime l. (auth)

44900 (UJV-1906) PANEL TO THE 10TH ANNIVERSARY OF THE REACTOR WWR-S IN NUCLEAR RESEARCH INSTITUTE REZ, CSSR. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Sept. 26, 1967. 53p. Dep.

The operations of the WWR-S reactor at Rez are described. The applications of the reactor for research experiments and radioisotope production are discussed. Neutron physics experiments and thermal neutron spectrum measurements are described. (D.C.C.)

44901 (UJV-2010) THE CALCULATION OF THE EFFECTIVE RESONANCE INTEGRALS, THE RESONANCE ESCAPE PROBABILITY, AND THE DOPPLER COEFFICIENT IN HETEROGENEOUS SYSTEMS. Stepanek, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). [1967]. 60p. Dep.

The basic theory of neutron resonance absorption in heterogeneous systems is discussed. Calculated values of materials constants are tabulated; resonance integral ratios are listed. Temperature coefficients and resonance integrals are shown graphically. 70 references. (M.L.S.)

44902 "REBORE" FOR A REACTOR. Engineering, 206: 192-3(Aug. 2, 1968).

In order to prepare the existing header assemblies for sealing the new vessel of the Canadian NRU reactor a remote-controlled grinding, boring and polishing machine was constructed. It comprises a 3-armed spider assembly carrying the tool and inspection heads, with hydraulic, pneumatic, and mechanical drives supplied through the central vertical stem. (UK)

44903 DEVICE FOR CONNECTING THE TRAVELLING PATHS FOR A REACTOR HORIZONTAL PLUG. Wase, Keizo (to Hitachi Ltd.). Japanese Patent 1967-15505. Aug. 26, 1967. Filed Feb. 8, 1963.

The method proposed provides an improved connection of the two paths for a horizontal plug when it is handled with a plug-handling machine. Onto the "ring-bridge" at the entrance of a horizontal experimental hole are fixed two protruding thick plates; the end is of an inclined plane, i.e., an angle in longitudinal section. In the plug handling machine two similar corresponding plates are fixed at the entrance with the inclined plane engaging the plane of the ring bridge. The plates of the handling machine are movable in the radial direction for the operation of the machine. (NSA of Japan)

44904 SELECTION OF SCATTERER FOR NEUTRON BEAM EXTRACTION FROM REACTOR THROUGH TANGENTIAL CHANNEL. Goshchitskii, B. N.; Gusev, V. V.; Zelenov, V. I.; Konstantinov, L. V.; Mikhailov, Yu. N.; Sidorov, S. K.; Chudinov, V. G. At. Energ. (USSR), 25: 21-5(July 1968). (In Russian).

The influence of material, geometry and position of scatterers put into a through tangential channel on characteristics of a neutron beam extracted has been studied. Measurements have been made with a tangential channel model and with water cooled and moderated reactor UBB-2 tangential channel. It has been shown that for low-absorption media (beryllium, graphite, lead, polyethylene, lucite) the beam intensity reaches a maximum value when the scatterer length is about five neutron scattering transport lengths. The neutron beam intensity is strongly dependent on the scatterer slope angle to the channel axis for polyethylene and lucite. When the slope angle amounts to about 10°, there is a 30% increase in the beam intensity as compared with that for a perpendicular scatterer. This relation is no more valid for graphite. The tangential channel with the scatterer makes it possible to obtain an intense collimated neutron beam with small background of fast neutrons and gamma-quanta. As compared with a radial beam, Cd ratio can be increased about 20 to 30 times as large; gamma background can be decreased about 50 to 70 times. (auth)

44905 STUDY OF HIGHLY ENRICHED $U{-}H_2O$ DEEP SUBCRITICAL SYSTEMS BY PULSED NEUTRON METHOD. Stumbur, E. A.; Matveenko, I. P.; Karchava, G. A.; Matveenko, V. I.; Shokod'ko, A. G. At. Energ. (USSR), 25: 13-15(July 1968). (In Russian).

The pulsed neutron method for determination of two group reactor-physics parameters for heterogeneous $U{-}H_2O$ systems has been developed. The method consists in replacement of the fission material by the absorber. Experimental results obtained on a number of subcritical assemblies correspond to theoretical calculations and critical experiment data. (auth)

44906 THE EURATOM CONFERENCE ON THE POSSIBILITIES FOR USING THE HIGH FLUX REACTOR (HFR). Lindhout, A. H. Atoomenergie Haar Toepass., 10: 49-53(Feb. 1968). (In Dutch).

The reactor is operated in periods of 6 weeks, during which it is shut down for 2 and 4 days respectively. Thermal neutron fluxes of the order of 10^{14} n/cm^2/sec are available for irradiation of samples in capsules for single or multiple use or in circuits with a circulating coolant. Measurement of experimental parameters during irradiation is preferably to be avoided for economic reasons. The hot laboratory is especially suited for the mechanical and chemical investigation of irradiated metals, including fuel elements, and their radiation products. (J.J.t B.)

44907 FILTER FOR FAST FLUX TESTING IN A THERMAL TEST REACTOR. Wood, R. E. (General Electric Co., Idaho Falls, Idaho); Kunze, J. F.; Sims, F. L.; Robertson, C. S. Jr. Nucl. Appl., 5: 105-13(Sept. 1968).

The present shortage of fast reactor test space, particularly for test regions greater than 2 cm in diameter, led to a series of tests to develop an adequate spectrum-hardening filter so that a suitable fast neutron flux environment could be obtained in a large thermal test reactor. A boron filter was the best of a number of filter materials tested, and verification measurements were made in the Engineering Test Reactor (ETR) Critical Experiment. After several design modifications, fast neutron flux spectra typical of the Experimental Breeder Reactor (EBR-II) were obtained at levels about $\frac{1}{2}$ of those obtainable in the peak region of the EBR-II but with a test hole diameter of 3.5 cm. Softer neutron spectra, typical of some of the proposed fast breeder designs, can be obtained in a filtered ETR experiment with fissile fission rates greater than those in the EBR-II. (auth)

44908 IMPROVEMENTS IN OR RELATING TO TEMPERATURE CONTROL SYSTEMS. Conte, Rolland (to Commissariat a l'Energie Atomique). British Patent 1,124,541. Aug. 21, 1968. Priority date Jan. 7, 1966, France.

A system is described which is used for controlling the temperature of an evaporable liquid in a closed loop occupied by a liquefied gas, which is in contact with its vapor and which experiences a thermosiphon circulation in the loop. In such loops, for example those for studying low-temperature irradiation of a specimen placed in the liquefied gas, it is often essential to maintain the temperature of the specimen, and therefore of the liquid, at a constant value even though the irradiation flux intensity varies, e.g., because of power variations of the flux-supplying reactor. (B.G.D.)

44909 CONTROL AND SAFETY OF PULSE REACTORS. Oakes, L. C. Nucl. Safety, 9: 363-72(Sept.-Oct. 1968).

The techniques employed in the instrumentation and control systems of three basic types of pulse reactors are considered: bare metal assemblies of the Godiva type, repetitive-pulse reactors of the IBR type, and low-energy neutron systems of the TRIGA type. Reactors in categories 1 and 3 depend on some type of inherent mechanisms for limiting the power pulse during normal operation, whereas those in category 2 depend on physical separation. Small amounts of reactivity in excess of that required to produce the maximum allowable pulse give rise to disproportionately large releases of energy. Thus the amount of reactivity manipulated by the operator must be known precisely. Further, since the reactor operates routinely on very short periods, electromechanical safety systems having sufficiently fast speed of response are impractical, and safety is obtained through administrative control. These considerations suggest that the probability for accidents in pulse reactors is somewhat higher than for accidents in conventional reactors. (26 references). (auth)

44910 MEASUREMENT OF LOW REACTIVITIES USING A REACTOR OSCILLATOR. Obradovic, D.; Petrovic, M. (Boris Kidric Inst. for Nuclear Sciences, Belgrade). Bull. Boris Kidric Inst. Nucl. Sci., Nucl. Eng., 18: No. 1, 1-9(Oct. 1967).

Most of the methods of measuring reactivity are limited to the region from several hundreds to several thousands of pcm. A method of measuring low reactivities from several pcm to slightly below 1000 pcm using the ROB-1 reactor oscillator on the RB reactor is described. (auth)

44911 INVESTIGATION OF RADIOACTIVE GAS CONCENTRATION IN AIR THROWN OUT OF CHIMNEY OF REACTOR IRT-1000. Mishev, I. T.; Khristova, M. G. At. Energ. (USSR), 24: 530-3(June 1968). (In Russian).

It was experimentally established that ^{41}Ar concentration in the air thrown out of the chimney of reactor IRT-1000-Sofia, is 1200 ± 30 pc/liter under reactor normal operating conditions at 1500 kW power. The total gas activity of the air thrown out into the atmosphere is 43 ± mc/h. The maximum concentration of ^{41}Ar in the above ground layer is 10 ± 2 pc/liter. It has been also experimentally established that the exhaust of the active gas ^{41}Ar from the experimental horizontal channel of the thermal column and from the space above the core tank water continues during many hours after stopping the reactor. (auth)

44912 IRRADIATION PLUG. Shimozato, Ato (to Hitachi Ltd.). Japanese Patent 1967-24627. Nov. 27, 1967. Filed June 25, 1964.

In the irradiation plug proposed, which is used for irradiating samples in a reactor, the difference in pressure between the loop running through the plug and the interior of the plug can be controlled. A sample container is located in the plug-cylinder at the end; this cylinder is closed with a shield at the other end. Piping runs through the sample container entering through the plug and leaving through it to supply the sample with a coolant, moderator, etc. Two other pipes also penetrate through the plug into the cylinder to supply the cylinder with an ambient inert gas. These pipes are open within the cylinder. Gas-pressure difference detectors are installed in the piping and pipes; and, gas-pressure control valves are installed in the pipes. (NSA of Japan)

44913 CALCULATION OF SPERT TRANSIENTS. Turner, W. J. (Australian Atomic Energy Commission, Sutherland). J. Nucl. Energy, 22: 397-409(July 1968).

A simple one-point model is presented which was used for calculations of SPERT transients in which boiling was the most important reactivity feedback mechanism. The calculated temperature was within 15°C of the measured temperature and was usually higher. (UK)

Production Reactors

Refer also to abstract 42933.

44914 (DPSPU-68-30-1) ON-LINE COMPUTERS AT THE SAVANNAH RIVER PLANT. Gimmy, K. L. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Plant). Jan. 1968. Contract AT(07-2)-1. 15p. Dep. CFSTI.

A description of the on-line digital computer control system for the Savannah River Production Reactor is presented. (D.C.C.)

44915 SYSTEMS FOR EXPERIMENTAL ISOTOPE IRRADIATION IN A PRODUCTION REACTOR. Cole, G. B.; Haase, G. F.; Kennedy, W. R. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Contract AT(07-2)-1. Nucl. Appl., 5: 179-82(Sept. 1968). (DPSPU-66-30-11).

Two sample transfer systems, one mechanical and one pneumatic, were developed for experimental isotope irradiations in Savannah River Plant production reactors. The systems operate through existing access ports, but independently of the production charge-discharge cycle. A unique device acquires and presents the penumatic carrier for counting. (auth)

Reactor Theory, Components, Fuels and Accessories

Refer also to abstracts 42587, 42588, 42944, 42950, 42995, 43002, 43029, 43055, 43170, 43519–43521, 43552, 43560, 43627, 43629, 43631, 43639, 43651, 43663, 43670, 44572, 44573, 44580–44582, 44593, 44674, and 44680.

44916 (ANL-Trans-651) STATISTICAL MODEL OF TWO-ZONE POINT REACTOR SYSTEMS. Kozik, B.; Li Khon Seb (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from report JINR-P-2828. 11p. Dep. CFSTI.

A two-point system which permits determination of the effects of the reflector upon the noise spectrum and correlation function of neutrons (Rossi α-method) in core-reflector (two-zone) systems is presented. If the two-point model is applied to a one-zone reactor, then this reduces to a consideration of the spatial extension of the reactor and permits an estimate of the upper frequency limit. Proof is presented. (D.C.C.)

44917 (BMI-X-10236) HEAT-RESISTANT CONCRETE FOR PRESTRESSED-CONCRETE-PRESSURE-VESSEL (PCPV) REACTORS. Quarterly Progress Report, April–June 1968. Lankard, David R.; Birkimer, Donald L.; Fondriest, F. Frederick; Snyder, M. Jack (Battelle Memorial Inst., Columbus, Ohio). July 1, 1968. Contract W-7405-eng-92. 7p. (EURAEC-2055). Dep. CFSTI.

Work performed under United States–Euratom Joint Research and Development Program.

The effects of heat exposure up to 500°F on the compressive strength and modulus of elasticity of concrete in which the free water is contained during heating and testing were investigated. Results of an x-ray analysis of cement samples subjected to the same heat and moisture conditions as specimens in other phases of study are reported. Weight changes and temperature data are presented for concrete in the moisture migration sphere maintained at 250°F in the center. (H.D.R.)

44918 (CONF-660669-1) THE RESPONSE OF A VESSEL TO AN INTERNAL BLAST LOADING. LIMITS OF MODEL TESTS INFLUENCE OF STRAIN-RATE. Holtbecker, H.; Maserati, A.; Montagnani, M.; Verzeletti, G. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). May 10, 1966. 63p. Dep.

From Meeting of Specialists on Shock-Structure Interactions in a Reactor, Ispra, Italy.

The feasibility is examined of carrying out tests on reduced-scale models, using explosives to simulate a blast loading inside a reactor vessel. The boundaries of such tests are established and the problems raised by the variation of the strain-rate are examined. The strain dynamics for a simple-geometry vessel (cylinder or sphere) are calculated, and experimental verifications are effected on reduced-scale models recording pressure and strain values simultaneously. The effects of the strain-rate are discussed. 23 references. (auth)

44919 (EIR-119) DYNAMIC NONLINEAR BEHAVIOR OF A REACTOR. Sarlos, G. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Feb. 1968. 98p. (In French). Dep.

Equations describing the nonlinear reactor dynamics are given; methods for treatment are discussed. Use of Lie series for solution to the system of differential equations is discussed; the derivation of recursion formulas is given. Methods for determination of reactor stability are discussed; fundamental theorems on stability are defined. The domain of reactor stability is determined. Dynamic characteristics of the EBWR and DIORIT are analyzed as examples; results of calculations are tabulated. 27 references. (M.L.S.)

44920 (GA-8622) LATTICE PHYSICS STUDIES. Quarterly Progress Report for the Period Ending March 31, 1968. Trimble, G. D.; Gozani, T.; Preskitt, C. A. (Gulf General Atomic, Inc., San Diego, Calif.). Apr. 15, 1968. Contract AT(04-3)-167. 58p. (EURAEC-2053). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

An experiment designed to include both geometry and density scaling in order to study the effect of a fuel rod cell reentrant hole on the perturbation of neutron spectral measurements is described. The experiment was designed to mock-up a single Pu rod in light water by use of a dummy fuel rod composed of a mixture of Al_2O_3 and Er_2O_3 powders. The techniques, results, and analysis of the reentrant tube perturbation experiment are presented. (H.D.R.)

44921 (KAPL-P-3397) COMPUTER DEVELOPMENT AND THE MODULAR PROGRAM. Kopp, H. H.; Lubert, M.; Schilling, W. E.; Turner, W. H. (Knolls Atomic Power Lab., Schenectady, N. Y.). Nov. 2, 1967. 20p. (CONF-671102-43). Dep. CFSTI.

From 15th Conference on Remote Systems Technology and Atom Fair, Chicago, Ill.

The NOVA system is a collection of reactor physics, mathematics, engineering and data reduction program modules used to design nuclear reactors. The more than 50 modules to the NOVA system can be executed in any arbitrary sequence. The uses and definitions of the NOVA modules are presented. (auth)

44922 (KFK-731) METHOD FOR THE EXPERIMENTAL INVESTIGATION OF THE NATURAL FREQUENCY OF THE NORMAL AND EXPANDED FUNCTION AS WELL AS THE ATTENUATION OF THE TRANSVERSE FUEL ROD VIBRATION. Kadlec, J.; Pfrommer, V. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Mar. 1968. 25p. (In German). (EUR-3718). Dep.

Methods for the experimental investigation of the eigenfrequencies, and the associated eigenfunctions, of fuel rods are described. Equations for a free swinging fuel rod are developed; from these, the equations of damped motion are derived. Experimental apparatus used for the measurements is described; the methods for measuring the resonance curve, phase, and amplitude are discussed. (M.L.S.)

44923 (MIT-334-55) RECENT STUDIES ON TERPHENYL COOLANTS. Mason, Edward A. (Massachusetts Inst. of Tech., Cambridge). [1966]. 44p. (CONF-660553-9). Dep. CFSTI.
From Panel on Use of Organic Liquids as Reactor Coolants and Moderators, Vienna, Austria.

Results obtained in the M.I.T. research program on terphenyl coolants are summarized, with special emphasis being given to the results obtained since 1962. At M.I.T., the effects of varying coolant composition, temperature, and neutron-to-gamma dose ratio on the rate of coolant degradation, physical properties, composition, and forced convection heat transfer were studied. A circulating in-pile loop located in the core of the MIT Reactor (MITR) was the principal experimental facility. The program also involved the development of methods for measurement of neutron and gamma ray dose rates by adiabatic calorimetry and neutron activation of foils and the development of various methods for analysis of gas and liquid samples of irradiated coolant. An important phase of the work was the correlation and the comparison of the results obtained with those reported by other laboratories in an attempt to develop consistent models for use in prediction of coolant performance in organic-cooled reactors. (auth)

44924 (ORNL-4287) FABCOST 9: A COMPUTER CODE FOR ESTIMATING FABRICATION COSTS FOR ROD-BUNDLE FUEL ELEMENTS. Lotts, A. L.; Washburn, T. N.; Homan, F. J. (Oak Ridge National Lab., Tenn.). Aug. 1968. Contract W-7405-eng-26. 135p. Dep. CFSTI.

FABCØST 9 was developed to achieve a quick, systematic estimation of fabrication costs with a reasonable degree of accuracy. This code is applicable to any fuel element consisting of an assembly of fuel rods. Both a general outline and specific details of the fabrication cost analysis are presented. Fabrication costs include the capital cost of the fabrication plant and equipment, the cost of operating the plant, and the cost of fuel element hardware. The cost of the fuel material is not included. It is assumed that U metal or UO$_2$ is the starting material; therefore, the cost of conversion to UC for fuel elements is included in the fabrication costs. The code follows the fabrication flowsheet for the fuel element being studied. It calculates process throughputs, based on the design parameters of the fuel element. The throughputs form the basis of capital cost of fabrication equipment and daily manpower requirements for each process. The capital and operating costs are summed over all the processes required by the flowsheet and factors corresponding to the design parameters of the fabrication plant are applied to the sums. Hardware costs are calculated on the basis of the cladding and structural material specified, the quantity, and the dimensions. Special alloying, testing, and tolerances are also considered in the hardware costs. 12 references. (auth)

44925 (TRG-Report-1662) EXPERIMENTS ON THE THERMAL BOWING OF SINGLE RODS SUPPORTED AT SEVERAL AXIAL POSITIONS. Rapier, A. C.; Jones, T. M. (United Kingdom Atomic Energy Authority, Risley (England). Reactor Group). Mar. 18, 1968. 20p. Dep. CFSTI. UK 2s. 6d.

Experiments to determine the change of shape of a single roughened rod supported with two or three equal-length spans are described. Separate experiments to determine the effect of rod displacement show that the coolant flow in the annular channel has a slight swirl. When this swirl is taken into account, the observed bowing is in good agreement with the theoretical predictions. Experiments in which this swirl is eliminated will provide more satisfactory confirmation of the theory. (auth)

44926 (WCAP-3677-8) FRACTURE MECHANICS EVALUATION OF REACTOR VESSEL STEELS. Quarterly Progress Report for the Period Ending June 30, 1968. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). July 1968. Contract AT(30-1)-3677. 39p. (EURAEC-2044). Dep. CFSTI.

Measured tensile properties and Charpy V-notch data for preirradiated A533 (Trade B Class 1 steel are presented. Postirradiation Charpy V-notch impact data are presented for A533 Grade B Class 1 steel. (D.C.C.)

44927 IMPROVEMENTS IN OR RELATING TO CHARCOAL FOR USE IN TRAPPING SYSTEMS. Taylor, Roland (to United Kingdom Atomic Energy Authority). British Patent 1,124,116. Aug. 21, 1968. Filed July 28, 1965.

A system for trapping fission product iodine in the form of methyl iodide in nuclear reactor installations is described. The system includes a bed of activated charcoal impregnated with an iodide of hydrogen, an alkali metal, and alkaline earth metal, iron, or nickel. Preferred impregnants are potassium iodide and potassium tri-iodide. (H.D.R.)

44928 IMPROVEMENTS IN OR RELATING TO THERMOCOUPLE CABLES. Guneratne, Piyatilleke Perera (to United Kingdom Atomic Energy Authority). British Patent 1,124,981. Aug. 21, 1968. Filed Feb. 8, 1965.

A method for severing a thermocouple cable inside a nuclear reactor so that the cable may be removed is described. A number of cables are disposed in a common guide and are provided outside the guide with a slack portion and a loop. A strain wire passes through the loop and is crimped inside ferrules on each side of the loop. By pulling on the cables from outside the reactor, the slack portion is taken up and the kinking of the cable as the loop closes up causes the cable to break. (H.D.R.)

44929 USE OF MODAL EXPANSIONS FOR THE DETERMINATION OF SPATIALLY DEPENDENT REACTOR TRANSFER FUNCTIONS. Paleocrassas, Stamatis Nicholas. Ames, Iowa, Iowa State Univ., 1967. 93p.
Thesis.

Two of the many modal approximation methods are utilized for the numerical solution of the space-time reactor equations. Furthermore, with the appropriate time frequency transformation the results are extended into spatially dependent reactor transfer functions. Both methods simplify the reactor equations by expanding each flux and precursor group into a series of ordinary orthogonal basis functions. However, the two approaches differ with regard to the choice of basis functions; one uses solutions of the Helmholtz equation while the other utilizes the natural modes of the reactor. (Disser. Abstr.)

44930 DEVICE FOR PREVENTING THE OUTFLOW OF COOLANT FROM A NUCLEAR REACTOR. Komeno, Jin (to Hitachi Ltd.). Japanese Patent 1967-17912. Oct. 17, 1967. Filed June 14, 1965.

The device proposed can completely stop the outflow of coolant from a nuclear reactor of which the core is immersed in coolant. A plate, with holes for passage of the coolant, is set in both the inlet and outlet of the reactor. A sort of "bag" is fixed onto the inside face of this plate, covering the center hole of the plate. In the normal internal pressure, i.e., when the reactor is in operation, this bag is inflated; but, when the pressure in the reactor has risen extremely due to a coolant-system damage, the bag is flattened due to this high pressure thereby covering the other holes of the plate; the result is the stoppage of coolant outflow from the reactor. (NSA of Japan)

44931 REACTOR-CORE ELEMENTS. Murota, Kazuo (to Nippon Atomic Industries Group Co., Ltd.). Japanese Patent 1968-862. Jan. 12, 1968. Filed Apr. 28, 1964.

A control sub-element and a fuel sub-element, constituting a reactor-control element, is described which can be joined when used in the reactor, and separated when exchanged for new ones. No guide tube is required outside the reactor core. In the reactor-control element, either the fuel or the control element can be connected or disconnected with respect to each other by means of the support plates for the fixed element. (NSA of Japan)

44932 DEVICE FOR SEPARATING THE PARTS OF A FUEL ELEMENT. Sasaki, Masayoshi (to Hitachi Ltd.). Japanese Patent 1967-24626. Nov. 27, 1967. Filed May 9, 1964.

The device proposed is used for separating the parts of a fuel assembly consisting of a series of fuel rods enclosed in the outside tube with coolant water running through the space between the rods surface and the tube. The operation of separation is performed in a pool water. The device consists of: the base; an upright column on the base; the upper support frame for the upper chuck to grab the element upper end; the lower support frame for the lower chuck to grab the lower end which also draws down the cut tube; and, the intermediate support frame for the intermediate or middle chuck to grab the middle which also supports the element cutter. All the horizontal support frames are installed on the upright column and move down or up along it. (NSA of Japan)

44933 FLUIDIZED-BED COATING APPARATUS. Pilloton, R. L. (to United States Atomic Energy Commission). U. S. Patent 3,398,718. Aug. 27, 1968.

Gas-solid contractor is described for coating discrete solid particles and includes a gas distributor plate of substantially conical section having an included angle between 100 to 150°. Associated gas manifold means are provided for passing a minor portion of the coating gas upwardly through a central aperture of the face plate and the remainder upwardly through peripheral apertures of the face plate. Coolant is supplied in heat transfer relationship to the bottom of the face plate for cooling the incoming coating gas. (AEC)

44934 METHOD FOR PRODUCING A TUBULAR NUCLEAR FUEL ELEMENT. Waraya, Takashi (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1967-19551. Oct. 2, 1967. Filed Oct. 26, 1964.

The method proposed has the following advantages: easy and high-accuracy fabrication of the fuel element, strong adhesion of core and cladding, and, little limitation to the proportion of contained U. Core material, in fused form, is attached onto the outer face of a cladding tube in individual small squares or in similar shapes. This outer face with "unattached" narrow spaces is covered with metal to give the outer cladding. Finally, the edges at both ends are firmly sealed. (NSA of Japan)

44935 METHOD FOR PRODUCING A TUBULAR NUCLEAR FUEL ELEMENT. Waraya, Takashi (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1967-19550. Oct. 2, 1967. Filed Oct. 20, 1964.

The method proposed has the following advantages: easy and high-accuracy fabrication of the fuel element, and no special limitation to the proportion of contained U. Core material, in fused form, containing fissile substance is attached onto the outer face of a (cladding) tube leaving the part at the ends. The whole face is then covered with metal to provide the outer cladding. (NSA of Japan)

44936 METHOD FOR PRODUCING A NUCLEAR FUEL PLATE. Waraya, Takashi (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1967-19549. Oct. 2, 1967. Filed Oct. 15, 1964.

The method proposed has the following advantages: avoidance of the prior fabrication of a fuel core, and, elimination of the separating of cladding and core. Core material in fused form containing fissile substance is attached onto one side of a cladding plate, about the middle part of it, forming a thick layer; this place of attachment is a shallow hollow. Two such plates are brought in contact with each other, the side of fuel attachment being inside. Then, the two plates are pressed hard together, to give a fuel plate. (NSA of Japan)

44937 SEALED-TYPE CONTROL-ROD DRIVING MECHANISM. Sato, Yusuke (to Hitachi Ltd.). Japanese Patent 1968-870. Jan. 12, 1968. Filed Mar. 15, 1965.

The sealed-type control-rod driving mechanism proposed for a pressure vessel-type reactor is capable of rapid driving of a control rod without any leakage, and its scram action is instantaneous. The positioning of a control rod is accurate. The drive mechanism consists of an outer cylinder at the top end of which is attached a reactance motor; an inner cylinder one end of which is connected to the control-rod driving cylinder by means of a hook and the other end has an electromagnet iron core; a means of nut, rods, etc., within the outer cylinder to convert the motor rotation to the shuttle motion with the armature at the other end joining the iron core; a permanent magnet fixed onto the nut; and, a gear system which operates a rod outside the outer cylinder with coils at both ends corresponding to the positions of iron core and permanent magnet, respectively. (NSA of Japan)

44938 TEMPORARY SHIELD FOR A NUCLEAR REACTOR. Oki, Arahiko (to Hitachi Ltd.). Japanese Patent 1967-19538. Oct. 2, 1967. Filed May 29, 1964.

An economical, temporary shield for a nuclear reactor is described. The shield is used to protect the personnel when fuel is exchanged. In the nuclear reactor filled with coolant water, a hot-water layer is produced on top of the coolant water, and also the inside of the upper part of the pressure vessel is washed by water spray when fuel is exchanged to protect the personnel from the coolant-water radiations. The layer hot-water and the spray water are supplied through the spray system. (NSA of Japan)

44939 DEVICE FOR CONTAINING A NUCLEAR REACTOR. Oki, Arahiko (to Hitachi Ltd.). Japanese Patent 1967-19547. Oct. 2, 1967. Filed Jan. 25, 1965.

The method proposed, with special reference to the time of a reactor accident, has the following advantages: simplification of the containment-vessel construction; and a reduced leak of radioactive gases into the atmosphere. It includes the following; a reactor; the internal containment vessel to contain the reactor; a vent valve installed at the top of this containment vessel to introduce water; the sealing and shielding water pool surrounding the internal containment vessel from which the water is supplied; the outer double-walled containment vessel of which the bottom etc., space between the walls forms a pressure suppression; a water-discharge pipe connecting the internal containment vessel and the pressure-suppression space; and, a pipe, connecting the double-walled space of the outer containment vessel and a stack in the atmosphere with a valve to be closed a proper time after a reactor accident. Before start of the reactor operation, the inner containment-vessel is filled with water by opening the vent valve. The valve is closed after filling. The water is then discharged into the pressure-suppression space through the discharge pipe to have a negative pressure in the vessel. When a reactor accident has occurred, pressure in the internal containment-vessel is released for a short time from the stack. Then, the valve in the pipe is closed, and, subsequently, the low-pressure steam (occurring as a result of the accident) is contained in the internal containment vessel. (NSA of Japan)

44940 METHOD FOR PREVENTING THE PRESSURE INCREASE INSIDE A NUCLEAR FUEL CONTAINER. Hiruta, Yasuo (to Hitachi Ltd.). Japanese Patent 1968-875. Jan. 12, 1968. Filed Jan. 13, 1965.

The method proposed is applicable for the containers to store or transport a spent or damaged fuel rod. The container with an irradiated fuel rod is filled with water. To absorb the pressure increase due to the fuel, a flexible "ball" containing a gas is placed within the water. (NSA of Japan)

44941 DEPENDENCE OF HEAT FLUX DISTRIBUTION ON FISSILE MATERIAL DISTRIBUTION IN FUEL. Grillo, P.; Testa, G. (Comitato Nazionale per l'Energia Nucleare, Rome). Nucl. Appl., 5: 130-9(Sept. 1968).

Hot spot factors due to fissile material segregation in UO_2-PuO_2 fuels and to geometrical tolerances in the fuel rods are calculated for both vibrationally compacted and pelleted fuels in order to produce optimum design for light water reactors. Neutron flux distribution in the fuel is calculated using the transport theory, while the trend of the heat flux transferred to the coolant is evaluated by a three-dimensional heat transfer code. Segregation of fissile material is significant for vibrationally compacted fuel, and appears negligible for pelleted fuel. The geometrical tolerances considered give values for engineering hot channel factors that are quite relevant for fuel rod design. 15 references. (auth)

44942 IMPROVED RESOLUTION IN ALPHA AUTORADIOGRAPHS. Jeffs, A. T. (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Nucl. Appl., 5: 91-3(Aug. 1968).

Alpha-autoradiography is used extensively to study the distribution of plutonium in fuels. The relatively high energy typical of plutonium alphas sets a limit on the resolution available when the normal contact technique is used. The resolution is markedly improved by using a thin absorber of a heavy metal (e.g., platinum) between the sample and the registrant film. (auth)

44943 THERMAL NEUTRON SPECTRA IN A HETEROGENEOUS LATTICE. I. FUNDAMENTAL RELATIONS. Grmela, Miroslav; Hron, Miloslav (Inst. of Nuclear Research, Rez, Czech.). Jad. Energ., 14: 177-81(May 1968). (In Czech).

Problems concerning the calculation of thermal neutron spectra with space and energy dependences for uses in nuclear reactors are presented. Methods of solutions are described. (auth)

44944 A SIMPLE PROCEDURE FOR CALCULATING BACKSCATTERING AND INTERACTION EFFECTS ON FAST FISSION FACTOR. Stefanovic, D. B. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Nukleonik, 11: 201-4(July 1968).

A simple procedure for the calculation of the backscattering and interaction effects on fast fission factor in the reactor lattice based on multigroup and Monte Carlo methods is presented. (auth)

44945 HEXAGONAL LATTICE COORDINATES. Duane, Bernard H. (Battelle-Northwest, Richland, Wash.). Nucl. Sci. Eng., 33: 336-9(Sept. 1968).

The Schwarz-Christoffel conformal mapping of the interior of a regular hexagon upon the interior of a circle has been integrated analytically, as a simple irrational function of the Weierstrass equianharmonic elliptic function. The hexagonal coordinate system thus generated has broad applicability to the nuclear, thermodynamic, and stress analyses of hexagonal lattice reactors. (auth)

44946 LAW ON NUCLEAR LIABILITY OF MARCH 8, 1968. Sv. Forfattningssamling, No. 45-56, 341-68(1968). (In Swedish).

Legal definitions are given on nuclear fuel, radioactive material, nuclear reactor, nuclear plant, siting country, owner of nuclear plant, nuclear accident, nuclear damage, Paris Convention of July 29, 1960, Addendum Convention Brussels Jan. 28, 1964 and convention country. Damages, insurance, and compensation from government are laid down for nuclear materials handling and nuclear plants operation in Sweden. (Swed.)

44947 THE USE OF BIPOLAR CO-ORDINATES IN SOLVING CRITICALITY PROBLEMS OF A SECANT SHAPED REACTOR. Sahni, D. C. (Bhabha Atomic Research Centre, Bombay). Nukleonik, 11: 204-8(July 1968).

A new method is developed to obtain the two lowest eigenvalues of the Helmholtz equation in a secant shaped reactor. The method uses bipolar co-ordinates and the inverse operator iteration technique. The lowest eigenvalue and the corresponding eigenvector are found to compare well with the two dimensional finite difference diffusion theory calculations. The next higher eigenvalue, important for time dependent problems, is also given. (auth)

44948 IMPROVEMENTS IN ELECTRIC MOTOR PUMP SETS. Michel, Andre (to Commissariat a l'Energie Atomique). British Patent 1,124,104. Aug. 21, 1968. Priority date Sept. 9, 1964, France.

Electric motor pump sets suitable for pumping nuclear reactor organic liquid moderators or coolants at high temperatures and pressures are described. The motor has a stator and a rotor separated by a woven silica fiber sleeve. Part of the pump output is diverted to flow within the sleeve for cooling and lubrication. The stator winding of the motor is formed by copper bars which are insulated by sleeves of high temperature resistant material. (H.D.R.)

44949 IMPROVEMENTS RELATING TO PROJECTION APPARATUS FOR PROTECTIVE BLANKETS OF DISPERSED LIQUIDS. Bulmer, George Henry (to United Kingdom Atomic Energy Authority). British Patent 1,120,623. July 24, 1968. Filed July 15, 1964.

A dual-jet spraying device for suppressing an airborne release of radioactive contamination from a reactor is described. The device consists of two projectors having nozzle diameters of at least one inch. The nozzles are arranged to produce converging jets with an included angle of 30° to 80°. The jets are pivotal on a framework which produces simultaneous by opposite motion. (D.C.C.)

GENERAL

44950 (AHSB(S)-R-153) THE CALCULATION OF RELIABILITY OF SYSTEMS THE PROGRAM NOTED. Woodcock, E. R. (United Kingdom Atomic Energy Authority, Risley (England). Authority Health and Safety Branch). 1968. 78p. Dep. CFSTI. UK.

There are many circumstances in which it would be useful to know the probability, as a function of time, that a device or system will perform in the desired manner when called upon to do so and how long it is likely to take to act. The systems can vary in complexity from a simple burglar alarm to a complete automatic protective system for a nuclear reactor, from a small electronic amplifier to a large electrical supply network with a prescribed maintenance schedule, and in numerous other fields. Practically all of these systems may be reduced to a logical flow network which is often of large size. The methods of analysis of logical flow networks are discussed. A versatile computer program that has been developed to deal with networks too large to be tackled by other methods is described. The solution of a sample problem is also described in detail in an Appendix. (auth)

44951 (IS-T-242) SUCCESSIVE STEP FORMATION CONSTANTS OF LANTHANIDE 2-PICOLINATES AND α-HYDROXY-α-METHYLBUTYRATES. Ingemanson, James William (Ames Lab., Iowa). May 1968. Contract W-7405-eng-82. 54p. Dep. CFSTI.

Thesis.

The first, second, third, and fourth formation constants for lanthanide 2-picolinates and α-hydroxy-α-methylbutyrates were determined at 25°C for 0.10 M ionic strength. The ratios of the first and second equilibrium constants were determined for both series. These were related to the statistical ratios after an approximation for coulombic and activity coefficient effects were made. The ratio treatment alone indicated bidentate ligand character on 8, 9, or 10 coordinate models for the 2-picolinates. Considering other structural and physical data, it appears most likely that the lighter, larger rare earth cations tend to be 10-coordinated in dilute aqueous media, and that a change to 9 coordination occurs at about the radius of Gd^{3+}. The ratio treatment coupled with the same physical data indicated that the α-hydroxy-α-methylbutyrates are constructed from tridentate ligands on a 10 coordinate cation model in the case of the light rare earths and from bidentate ligands on a 9 coordinate model with the heavy rare earths. (auth)

44952 (ITEF-561) ON THE METHOD OF STEEPEST DESCENTS. Kolkunov, V. A.; Meiman, N. N.; Nikolaevskii, E. S.; Petrukhin, V. N. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1967. 24p. (In Russian). Dep.

Formal expansions of contour integrals using the saddle point method are investigated. All the terms of the saddle point series are obtained in the explicit way through the integrand function. To expand the class of calculated contour integrals, a modified saddle point method is proposed which takes into account singularities closest to the dependence region of a saddle point. Convergence and applicability of the saddle point when the large parameter is absent are discussed by specific examples. The application of the modified saddle point method to the calculation of the phase space volume is given in detail and the algorithm of the computer program is presented. (auth)

44953 (LA-3919) ADVANCED TRANSIENT WAVEFORM RECORDING TECHNIQUES. Partridge, Ralph E. (Los Alamos Scientific Lab., N. Mex.). June 1968. Contract W-7405-eng-36. 63p. Dep. CFSTI.

New techniques for transient waveform recording are required for situations where application of conventional oscilloscope-camera combination approach is not feasible. The recording process is studied in fundamental terms. Avenues to be explored are indicated. New devices and technologies which can be applied are examined. The progress made on this and related problems in the recent past is outlined. (auth)

44954 (NTO-T-0026) NUCLEAR PHYSICS MADE VERY, VERY EASY. Hanlen, D. F. (Westinghouse Electric Corp., Jackass Flats, Nev.); Morse, W. J. (Aerojet-General Corp., Jackass Flats, Nev.). July 1968. 84p. DTIE Free.

A general introduction to atomic, nuclear, and reactor physics is presented for non-nuclear technical personnel. (J.W.R.)

44955 (ORNL-4232) DETERMINATION OF URINARY CONSTITUENTS IN SOLUTIONS BY LEAST-SQUARES RESOLUTION OF ULTRAVIOLET SPECTRA. Davis, W. Jr.; Schonfeld, E.; Kibbey, A. H. (Oak Ridge National Lab., Tenn.). July 1968. Contract W-7405-eng-26. 55p. Dep. CFSTI.

Least-squares resolution of uv spectra was tested as a method for determining the concentration of each uv-absorbing urinary component in a multicomponent solution. The tests reported involved solutions containing 4 to 12 components chosen from 17 reference materials, namely, p-aminobenzoic, anthranilic, ascorbic, ferulic, hippuric, p-hydroxybenzoic, uric, vanillic, and xanthurenic acids, adenine, creatinine, cytosine, ergothioneine, hypoxanthine, indican, N-methylnicotinamide, and tryptophan. Spectra of these reference and multicomponent solutions were measured from 1900 to 4000 A, rather than over the more usual range of 2200 to 4000 A; concentrations of individual components in unbuffered water solutions were in the range 0.4 to 100 mg/liter. While the maximum number of solutes capable of being analyzed by this method cannot be given, this brief study shows that as many as 10 uv-absorbing urinary components could be determined quantitatively by least-squares resolution of the spectrum of the solution. All of the 17 species used in this study showed absorption in the region 1900 to 2200 A; measurements in this region contributed greatly to the accuracy with which concentrations could be calculated. (auth)

44956 (ORNL-4282) ALGORITHM FOR INITIAL VALUE PROBLEMS. Altom, Donald W.; Morris, William L. (Oak Ridge National Lab., Tenn.). Aug. 1968. Contract W-7405-eng-26. 39p. Dep. CFSTI.

A new variable step algorithm for the numerical solution of systems of first order ordinary differential equations is presented. The algorithm has been coded as a FORTRAN subroutine and is available in the ORNL Subroutine Library as subroutine number D02013. (auth)

44957 (SC-DR-67-693-A) ANNOTATED LISTING OF A COMPUTER PROGRAM FOR SYNTHESIS OF MULTIPLE-OUTPUT ALL NAND COMBINATIONAL-LOGIC CIRCUITS. Maschoff, L. W. (Sandia Corp., Albuquerque, N. Mex.). July 1968. Contract AT(29-1)-789. 19p. Dep. CFSTI.

An annotated main program and all subroutines required to evaluate the heuristic presented in SC-DR-67-693 and to synthesize combinational-logic circuits are presented. (auth)

44958 (SC-R-68-1717) INDEX TO SANDIA CORPORATION PUBLICLY RELEASED REPORTS, 1963-1967. (Sandia Corp., Albuquerque, N. Mex.). Aug. 1968. 133p. CFSTI.

A computer-generated permuted title index for Sandia Corporation publicly released reports, 1963-1967, is presented. (B.G.D.)

44959 (SC-T-68-1534) FLUID TYPE LOGIC ELEMENTS. Torresan, Carlo. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.), from Riv. Ing., 17: 715-20 (1968). 15p. Dep. CFSTI.

Fluid-type logic elements without moving parts or with parts subjected to micromovements are described. Boolean algebra, digital amplifiers, proportional amplifiers, membrane elements, and auxiliary organs are discussed. (W.H.K.)

44960 (TID-85(6th Rev.)) REPORT NUMBER SERIES USED BY THE DIVISION OF TECHNICAL INFORMATION IN CATALOGING REPORTS. White, Helen W. (comp.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). Sept. 1967. 159p. Dep. CFSTI.

An alphabetical listing of report series codes identified with the corporate or issuing organization and a listing of the organizations followed by the report series each has issued are presented. The names of the issuing organizations generally appear in the form used at the time the reports were descriptively catalogued. (J.F.P.)

44961 (TID-3747) BIBLIOGRAPHIES OF ATOMIC ENERGY LITERATURE. Issued or in Progress During the Period, May-June 1968. (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). 11p. DTIE Free.

A list of ninety-two bibliographies issued or in preparation during the period May-June 1968 on atomic energy literature is presented. A report number index is also included. (B.G.D.)

44962 (TID-4579(2nd Ed.)) SERIAL TITLES CITED IN NUCLEAR SCIENCE ABSTRACTS. (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). July 1968. 273p. CFSTI.

A list of titles is presented representing the serials from which articles are abstracted in Nuclear Science Abstracts, including both those serials scanned and those selected for citation from other abstract journals, from bibliographies, and from reprints received from authors. (B.G.D.)

44963 (UCRL–50364(Pt.1)) CHROMOSOME SCANNING PROGRAM AT LRL. PART I. CHROMO, A SET OF CHROMOSOME PATTERN-RECOGNITION PROGRAMS. Stone, Stuart P. (California Univ., Livermore. Lawrence Radiation Lab.). Nov. 25, 1967. Contract W-7405-eng-48. 112p. Dep. CFSTI.

CHROMO is the name given to a set of computer programs developed during the past 18 months to process the data obtained from the scans of 35-mm film by the film-reader. Described in detail here is a particular set of CHROMO programs developed specially to process the scan data from the vellum film. Three groups of routines are considered: the scan-data collection routines written for an IBM-7094 computer to which the film-reader is attached; the main set of chromosome pattern-recognition routines written in an LRL Fortran language (Fortran 400) for CDC computers; and a group of result-retrieval and updating routines also written for CDC computers. Particular attention is given to the second group, with emphasis on procedures for object-boundary searching, centromere location, and arm-length measurements. (auth)

44964 (UCRL–50412) SOLUTION OF THE TIME-DEPENDENT EQUATIONS FOR TAUTOMERIC INTERCONVERSION IN THE A-T AND G-C BASE PAIRS OF DNA. Rozsnyai, Balazs (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 10, 1968. Contract W-7405-eng-48. 28p. Dep. CFSTI.

This report gives solutions of a set of four first-order coupled differential equations governing the tautomeric interconversion rate of the DNA base pairs are presented. The method of calculation represents a simplified way of treating the quantum mechanical tunnel effect for the protons forming the hydrogen bonds between the nucleotide base pairs of DNA. Results are presented for the A–T and G–C base pairs for several cases of interest. (auth)

44965 (UCRL–50434) CROSSLINKING POLY(2,2-DINITROPROPYL ACRYLATE) IN PLASTIC-BONDED EXPLOSIVES. Dodds, Duncan E.; Bissell, Eugene R. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 1968. Contract W-7405-eng-48. 20p. Dep. CFSTI.

Poly(2,2-dinitropropyl acrylate) (DNPA) was crosslinked in RX-09 formulations by esterifying carboxyl groups on polymer chains with a diepoxide. Carboxyl groups were introduced on the polymer chain by copolymerizing DNPA monomer with acrylic acid or by hydrolyzing some of the ester groups in DNPA. RX-09 formulations were prepared by aqueous slurry, which involved the addition of an ethyl acetate solution of the binder system and bis(2-fluoro-2-2-dinitroethyl) formal (FEFO) to an aqueous dispersion of 1, 3, 5, 7-tetranitro-1, 3, 5, 7-tetrazacyclooctane (HMX). Crosslinking the DNPA reduced the creep of RX-09 by about 20% when the DNPA contained 17.3 mole % carboxyl group. Beam bend and compressive strengths of RX-09 were increased by crosslinking DNP containing 6.0 mole % carboxyl groups. (auth)

44966 (UCRL-Trans–10255) USING MASSIVE EXPLOSIONS TO DIG CAVITIES IN ROCK. Alekseev, E. P. Translated by L. Toyle for Univ of California Lawrence Radiation Lab., Livermore, from Transp. Stroit., 16: No. 3, 4-6(1966). 10p. Dep. CFSTI.

Slope steepness obtained with massive explosions depends on rock strength and blasting methods. The methods are described for the Abakan-Taishet railway. Of the 123 large rock cavities blasted out for the railway bed, 108 were to loosen the rock and soil, 15 for ejection. (J.C.W.)

44967 THE ROLE OF AECL LABORATORIES. Haywood, L. R. (Chalk River Nuclear Labs., Can.). Nucl. Eng., 13: 516-18(June 1968).

The departments represented in the Whiteshell and Chalk River Laboratories include biology, chemistry, physics, medicine, materials science, and mechanical, electrical, civil, and metallurgical engineering. The role of the laboratories is illustrated by a discussion of the part played by them in the Gentilly Project. (UK)

44968 ATOMIC ENERGY CONTROL BOARD [CANADA]. Nucl. Eng., 13: 504(June 1968).

The constitution of the Board and its areas of activity are described. The primary function of the Board is to make provision for the control and supervision of the development and use of atomic energy, and to enable Canada to participate effectively in measures for international control that may be agreed upon. An appended chart shows the relationships between the government bodies, research facilities, reactor projects, and industrial companies. (UK)

44969 APPLICATION OF NUCLEAR PHYSICS TO ALLIED SCIENCES AND TO NATIONAL ECONOMY. Leipunskii, A. I. Usp. Fiz. Nauk, 95: 15-23(May 1968). (In Russian).

A survey of the development and applications of nuclear physics in the Soviet Union is presented. Nuclear engineering, power reactors, and the technology of materials are emphasized. (D.C.W.)